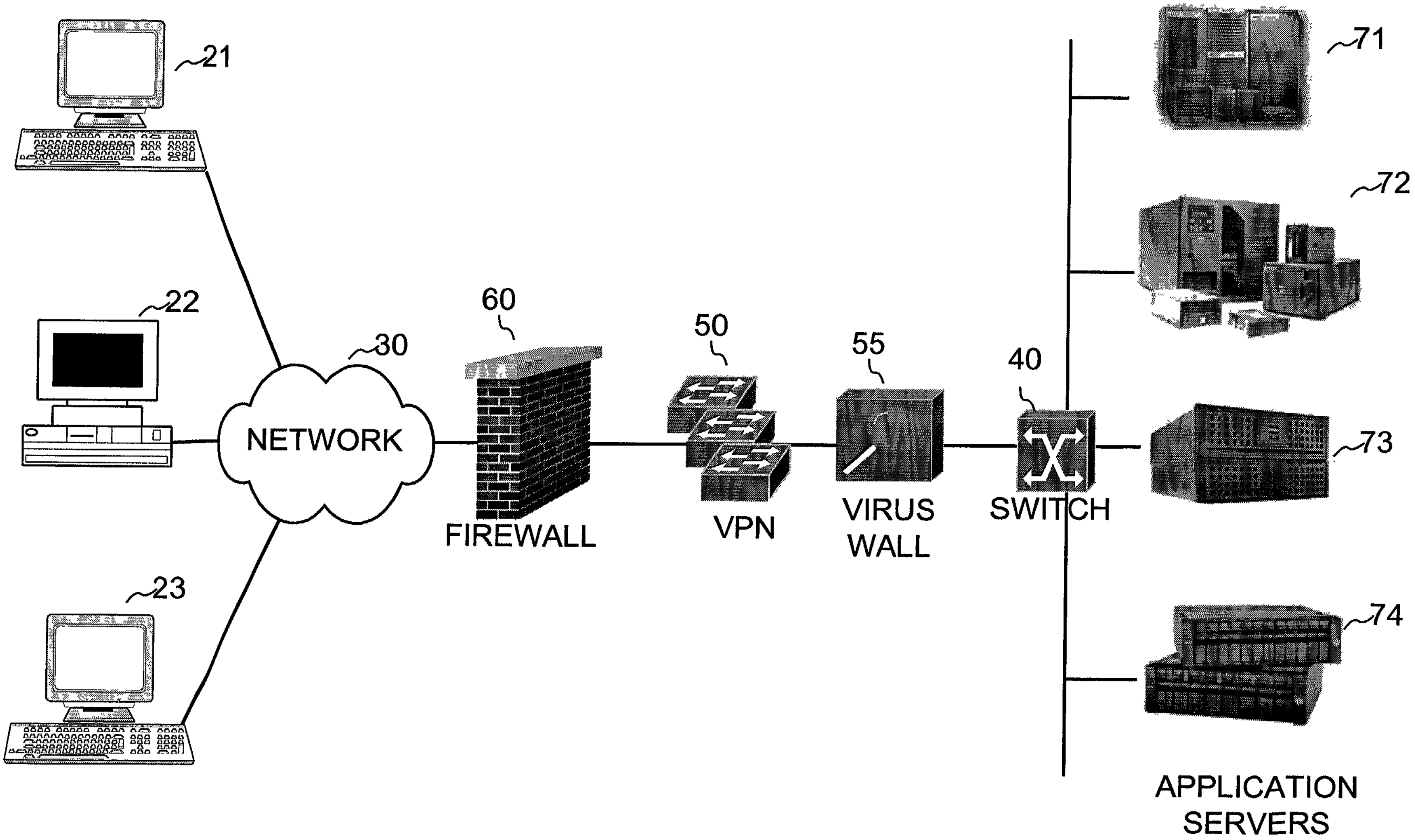

21
22
23
NETWORK
30
60
FIREWALL
50
VPN
55
VIRUS
WALL
40
SWITCH
71
72
73
74
APPLICATION
SERVERS

FIG. 1

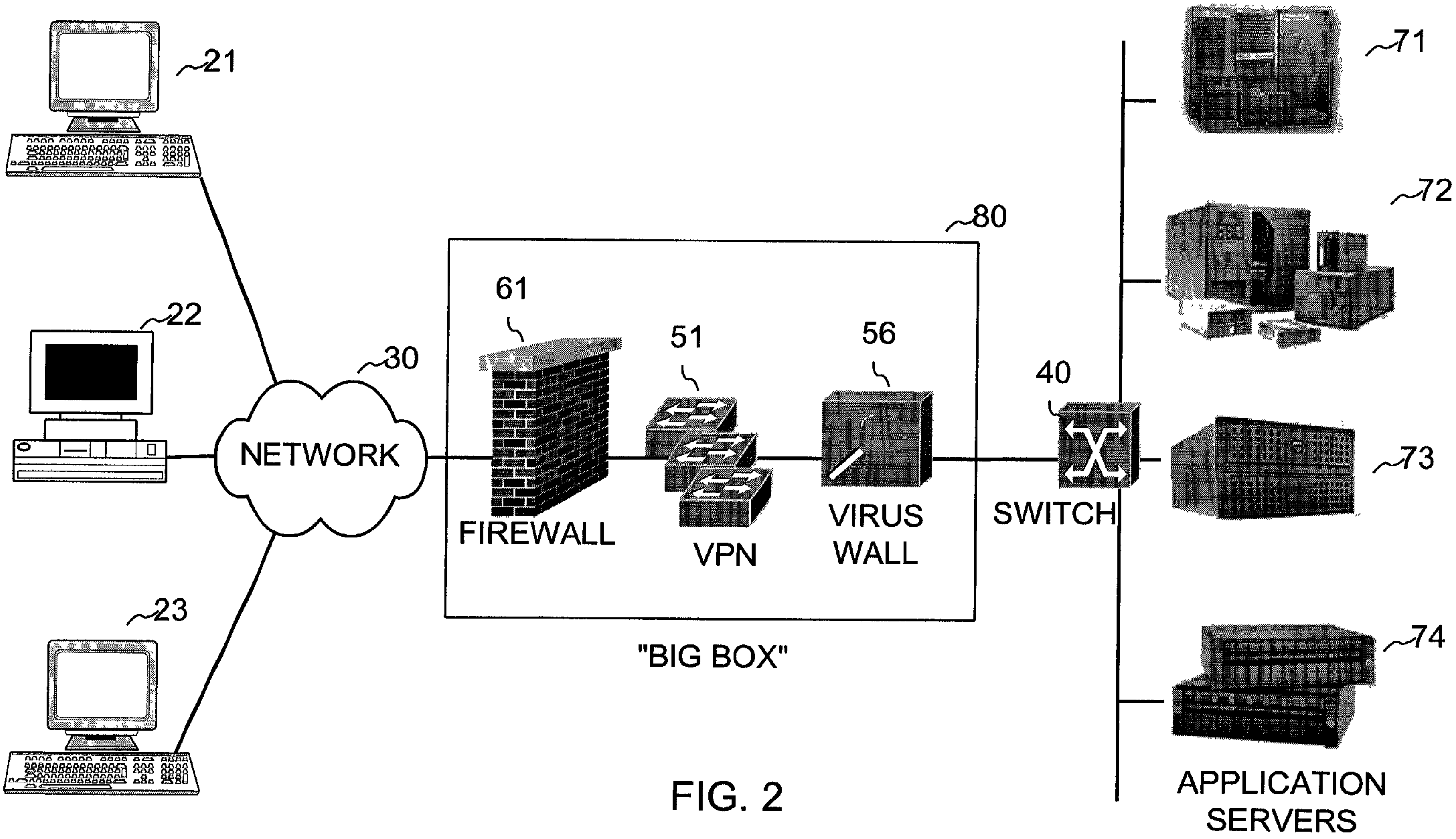

21
22
23
NETWORK
30
80
61
FIREWALL
51
VPN
56
VIRUS WALL
"BIG BOX"
40
SWITCH
71
72
73
74
APPLICATION SERVERS

FIG. 2

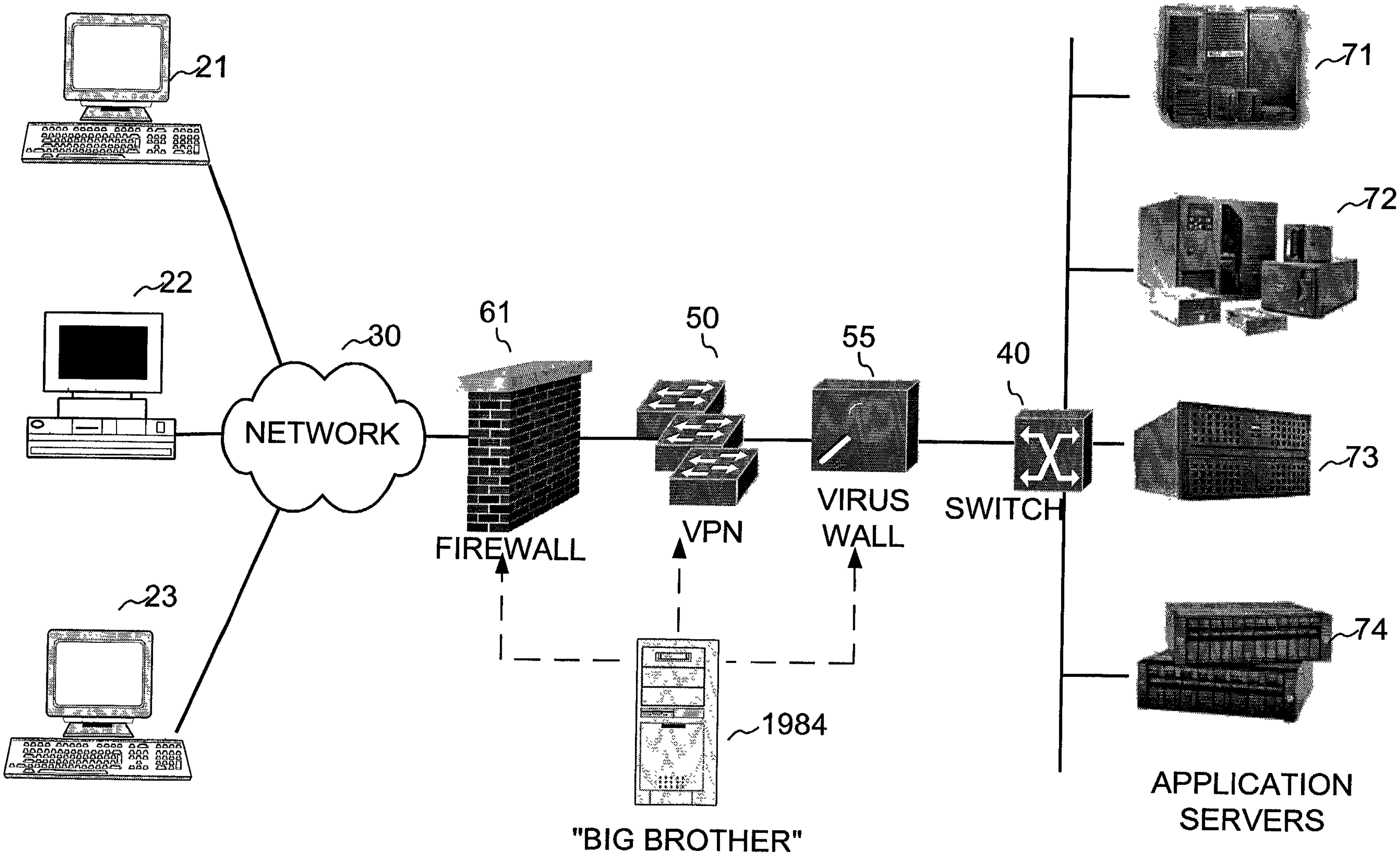

21
22
23
30
NETWORK
61
FIREWALL
50
VPN
55
VIRUS WALL
40
SWITCH
71
72
73
74
APPLICATION SERVERS
1984
"BIG BROTHER"

FIG. 3

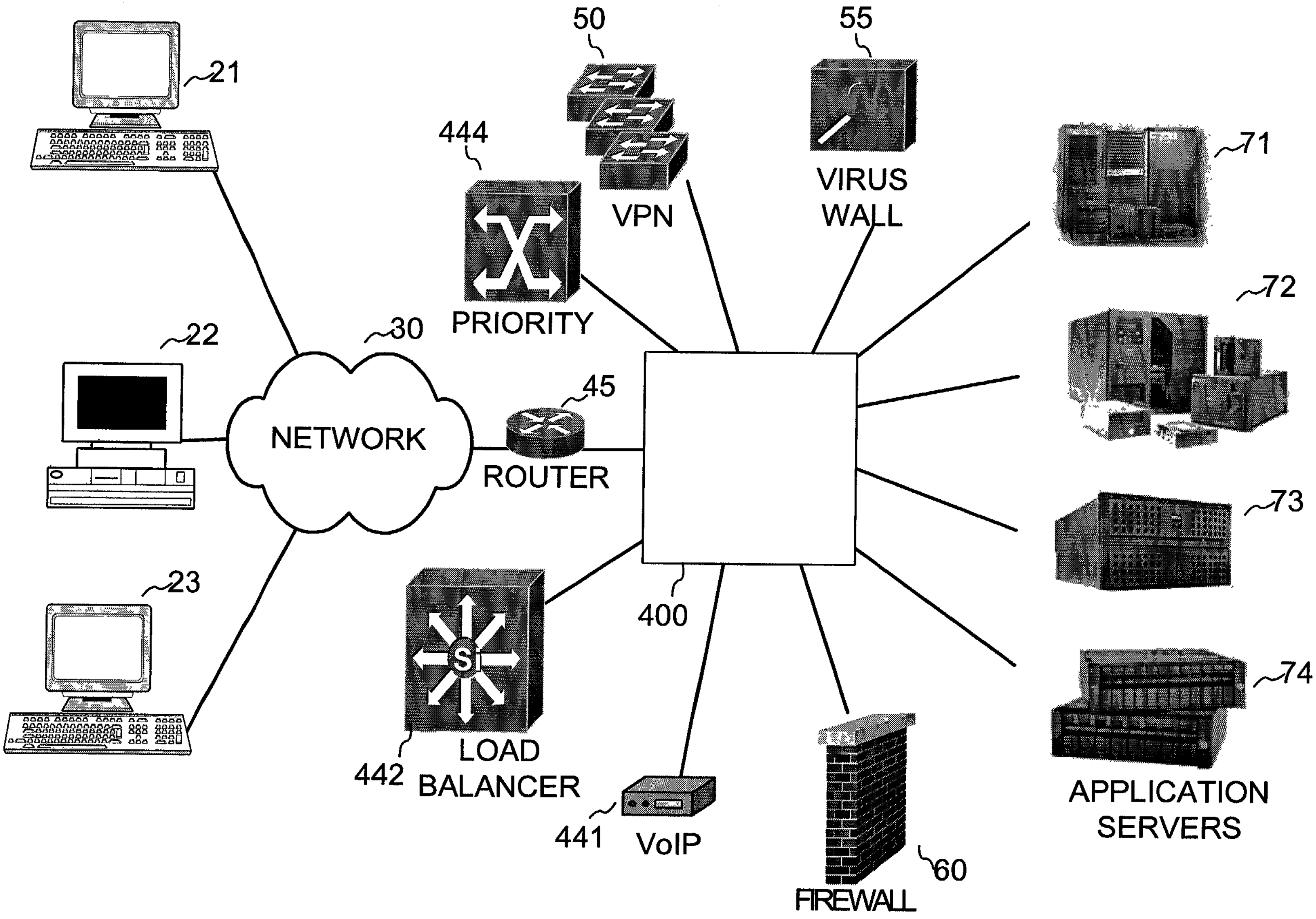

21
22
23
NETWORK
30
444
PRIORITY
45
ROUTER
50
VPN
55
VIRUS WALL
400
442
LOAD BALANCER
441
VoIP
60
FIREWALL
71
72
73
74
APPLICATION SERVERS

FIG. 4

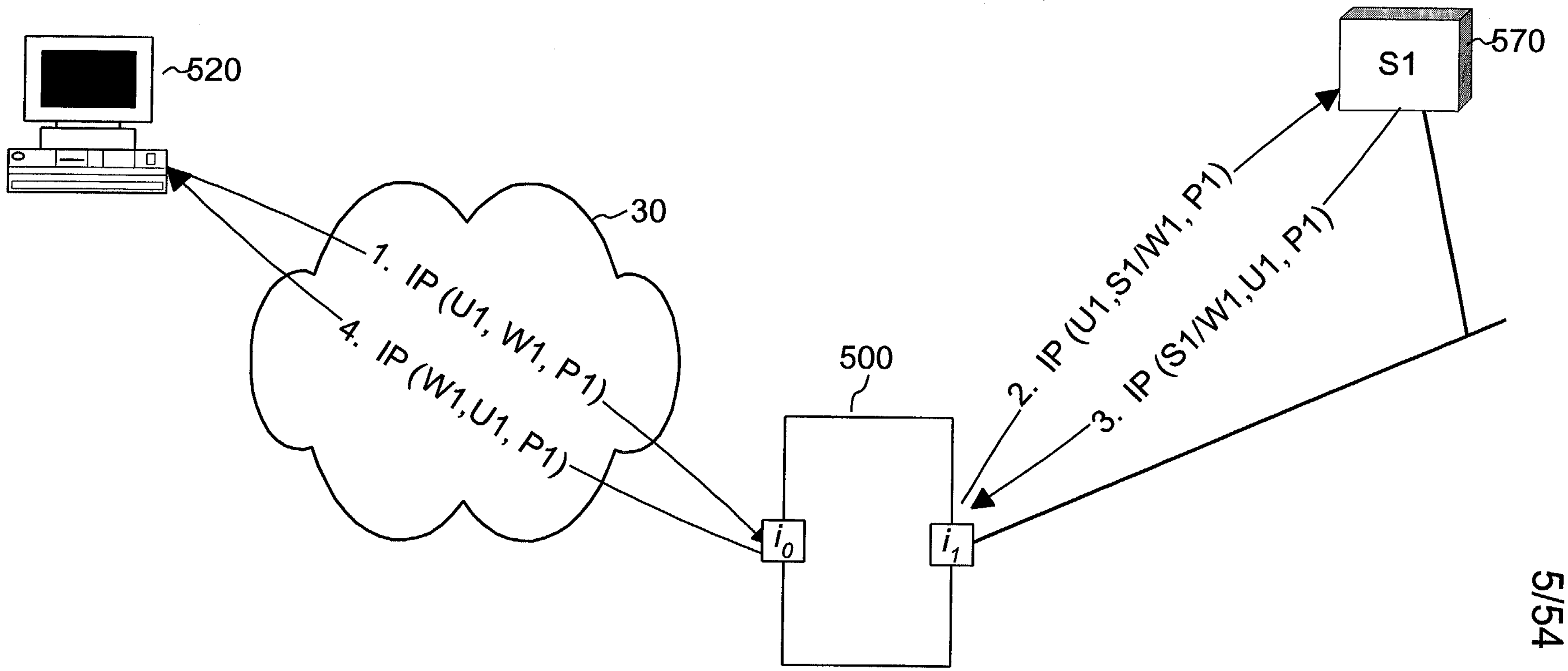

520
30
1. IP (U1, W1, P1)
4. IP (W1,U1, P1)
500
i_0
i_1
2. IP (U1,S1/W1, P1)
3. IP (S1/W1,U1, P1)
S1
570

FIG. 5

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1 (SERVER)	U1	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	P1
3	S1	PACKETING ENGINE	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

531

FIG. 5A

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	W1	P1
3	S1	PACKETING ENGINE	W1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

533

FIG. 5C

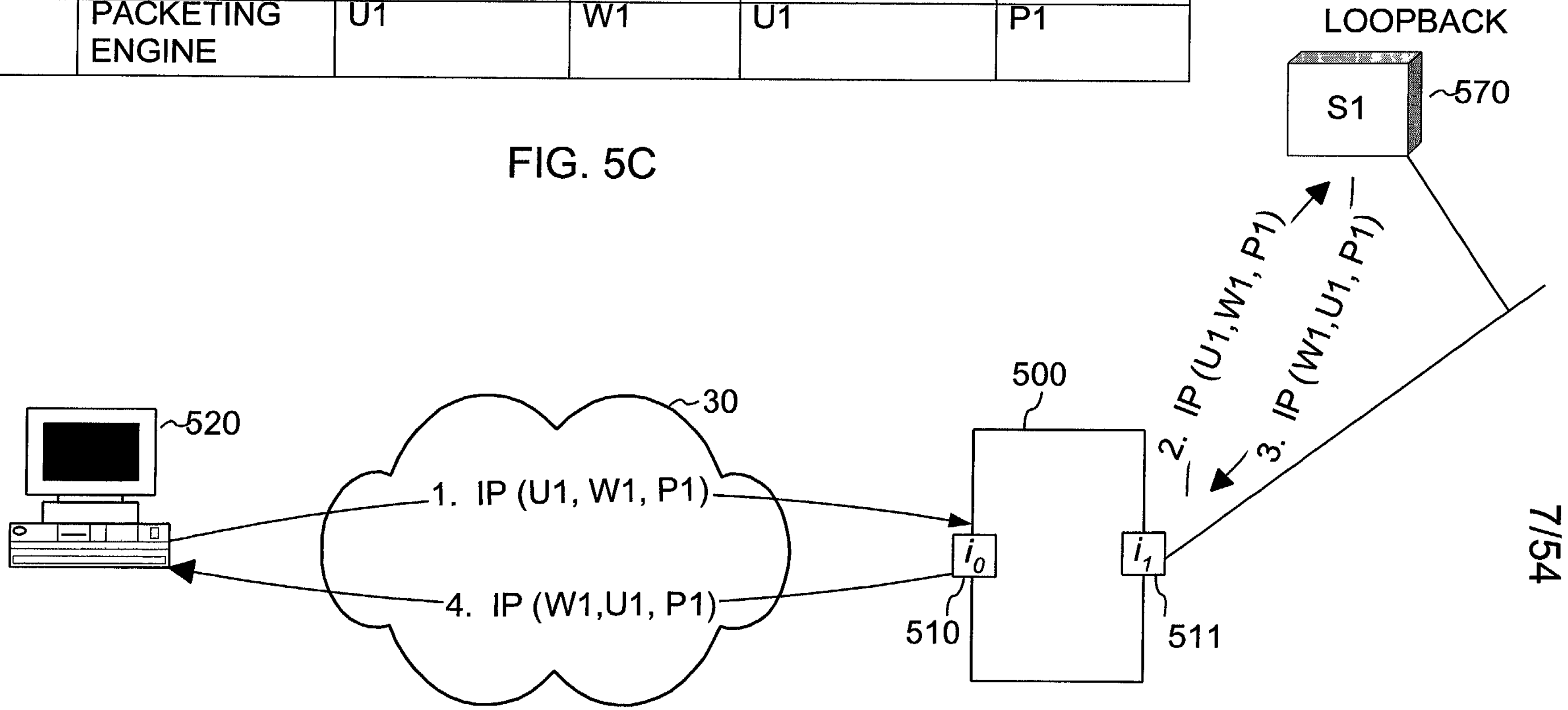


FIG. 5B

TABLE MAINTAINED BY PACKETING ENGINE								
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE			
RECEIVED ON INTERFACE	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND FROM INTERFACE	DEST. SYSTEM TYPE	SEND PACKET TO	
	MAC	IP					MAC	IP
I_0			W1	P1	I_1	LOOPBACK	$S1_M$	W1
I_1	$S1_M$	W1		P1	I_0	ROUTER		DEFAULT ROUTE

534

FIG. 5D

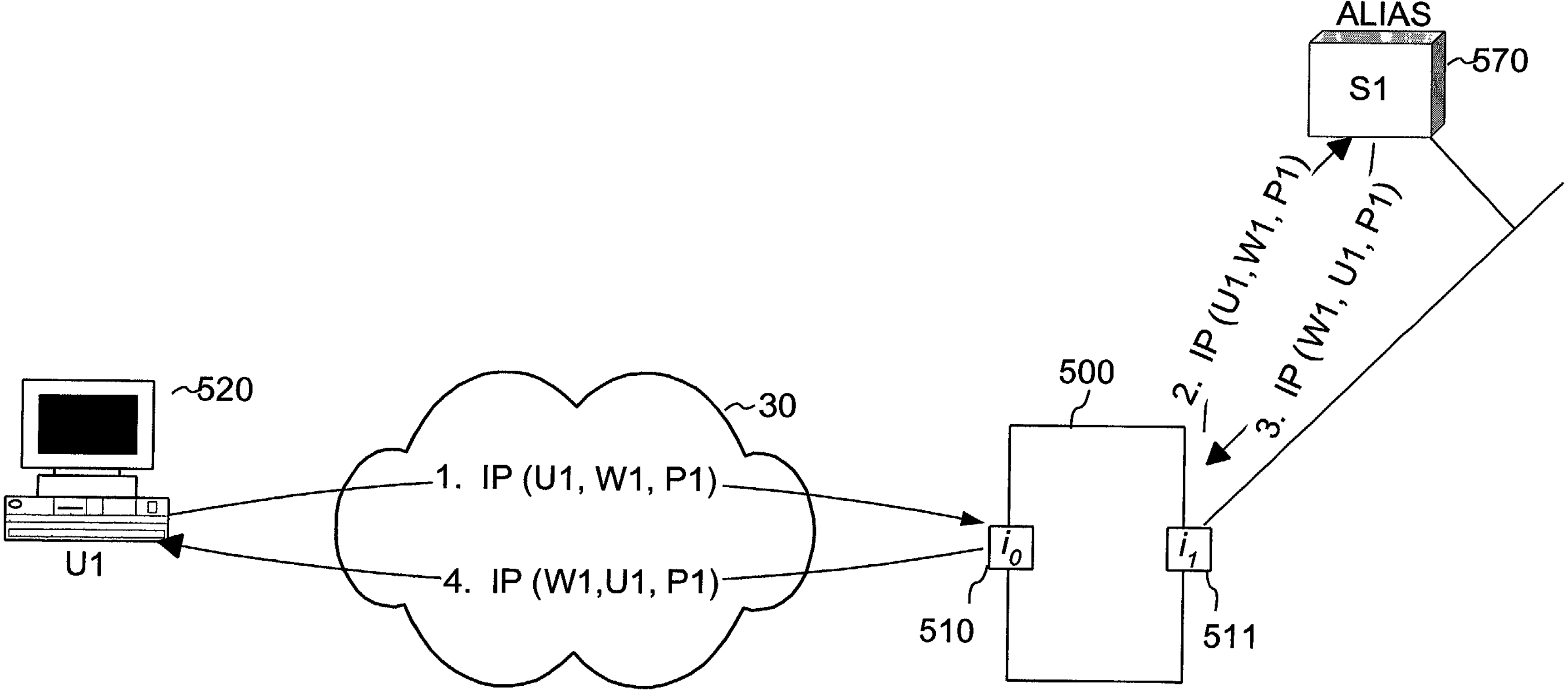


FIG. 5E

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	W1	P1
3	S1	PACKETING ENGINE	W1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

536

FIG. 5F

<table>
<tr><th colspan="10">TABLE MAINTAINED BY PACKETING ENGINE</th></tr>
<tr><th colspan="5">RECEIVE PACKET INBOUND TO PACKETING ENGINE</th><th colspan="5">SEND IT OUTBOUND FROM PACKETING ENGINE</th></tr>
<tr><th rowspan="2">RCX ON INT.</th><th colspan="2">SOURCE ADDRESS</th><th rowspan="2">DESTINATION IP ADDRESS</th><th rowspan="2">SERVICE PORT</th><th rowspan="2">SEND VIA INT.</th><th rowspan="2">DEST. SYSTEM TYPE</th><th colspan="2">SEND PACKET TO</th></tr>
<tr><th>MAC</th><th>IP</th><th>MAC</th><th>IP</th></tr>
<tr><td>I_0</td><td>▨</td><td>▨</td><td>W1</td><td>P1</td><td>I_1</td><td>ALIAS</td><td>$S1_M$</td><td>W1</td></tr>
<tr><td>I_1</td><td>$S1_M$</td><td>W1</td><td>▨</td><td>P1</td><td>I_0</td><td>ROUTER</td><td>▨</td><td>DEFAULT ROUTE</td></tr>
</table>

537

538

FIG. 5G

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1	U1	S1	P1
3	S1	PACKETING ENGINE	S1	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1

539

FIG. 5I

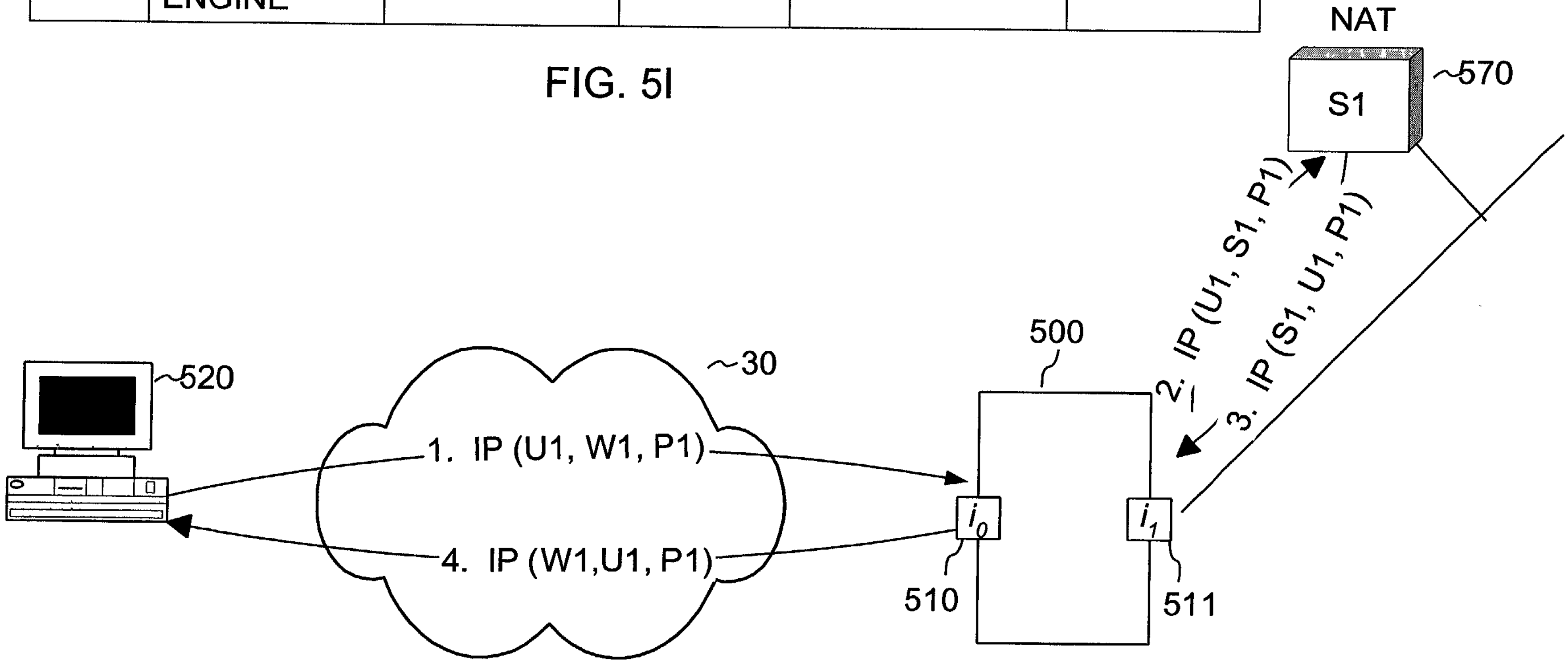


FIG. 5H

TABLE MAINTAINED BY PACKETING ENGINE						
RECEIVE PACKET INBOUND TO PACKETING ENGINE				SEND IT OUTBOUND FROM PACKETING ENGINE		
RCX ON INT.	SOURCE IP ADDRESS	DESTINATION IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO IP ADDRESS
I_0	▨	W1	P1	I_1	NAT REQUIRED	S1
I_1	S1	▨	P1	I_0 (AFTER REVERSE NAT SOURCE IP TO W1)	ROUTER	DEFAULT ROUTE

540

FIG. 5J

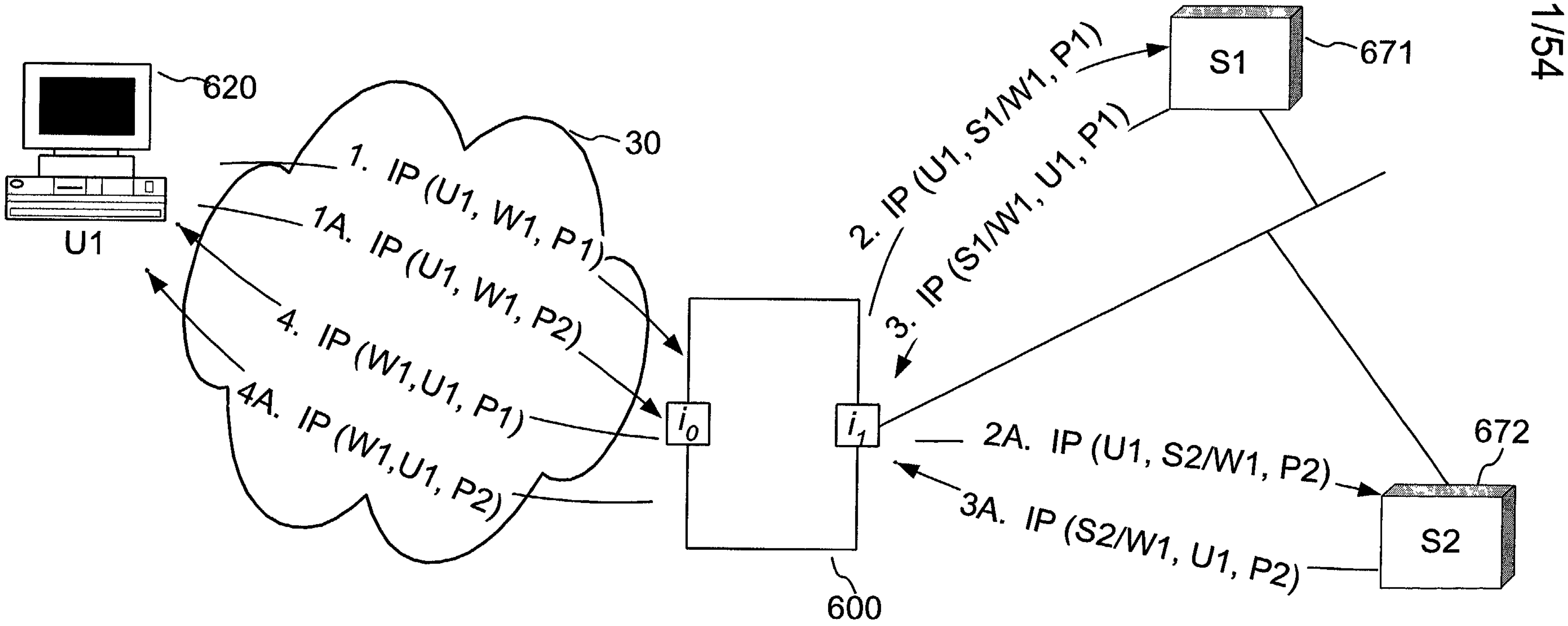


FIG. 6

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
PORT P1					
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	S1 (SERVER)	U1	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	P1
3	S1	PACKETING ENGINE	S1 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P1
4	PACKETING ENGINE	U1	W1	U1	P1
PORT P2					
1A	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P2
2A	PACKETING ENGINE	S2 (SERVER)	U1	S2 (IF NAT IS REQUIRED); W1 (IF S2 SUPPORTS LOOPBACK OR ALIAS)	P2
3A	S1	PACKETING ENGINE	S2 (IF NAT IS REQUIRED); W1 (IF S1 SUPPORTS LOOPBACK OR ALIAS)	U1	P2
4A	PACKETING ENGINE	U1	W1	U1	P2

631

FIG. 6A

TABLE MAINTAINED BY PACKETING ENGINE								
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE IP ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO	
	MAC	IP					MAC	IP
I_0	▨	▨	W1	P1	I_1	LOOPBACK	$S1_M$	W1
						ALIAS	$S1_M$	W1
						NAT		S1
I_1	$S1_M$	W1		P1	I_0	ROUTER		DEFAULT ROUTE
	$S1_M$	S1			I_0 (AFTER REVERSE NAT SOURCE IP TO W1)			
I_0	▨	▨	W1	P2	I_1	LOOPBACK	$S2_M$	W1
						ALIAS	$S2_M$	W1
						NAT		S2
I_1	$S2_M$	W1	▨	P2	I_0	ROUTER	▨	DEFAULT ROUTE
	$S2_M$	S2			I_0 (AFTER REVERSE NAT SOURCE IP TO W1)			

632

FIG. 6B

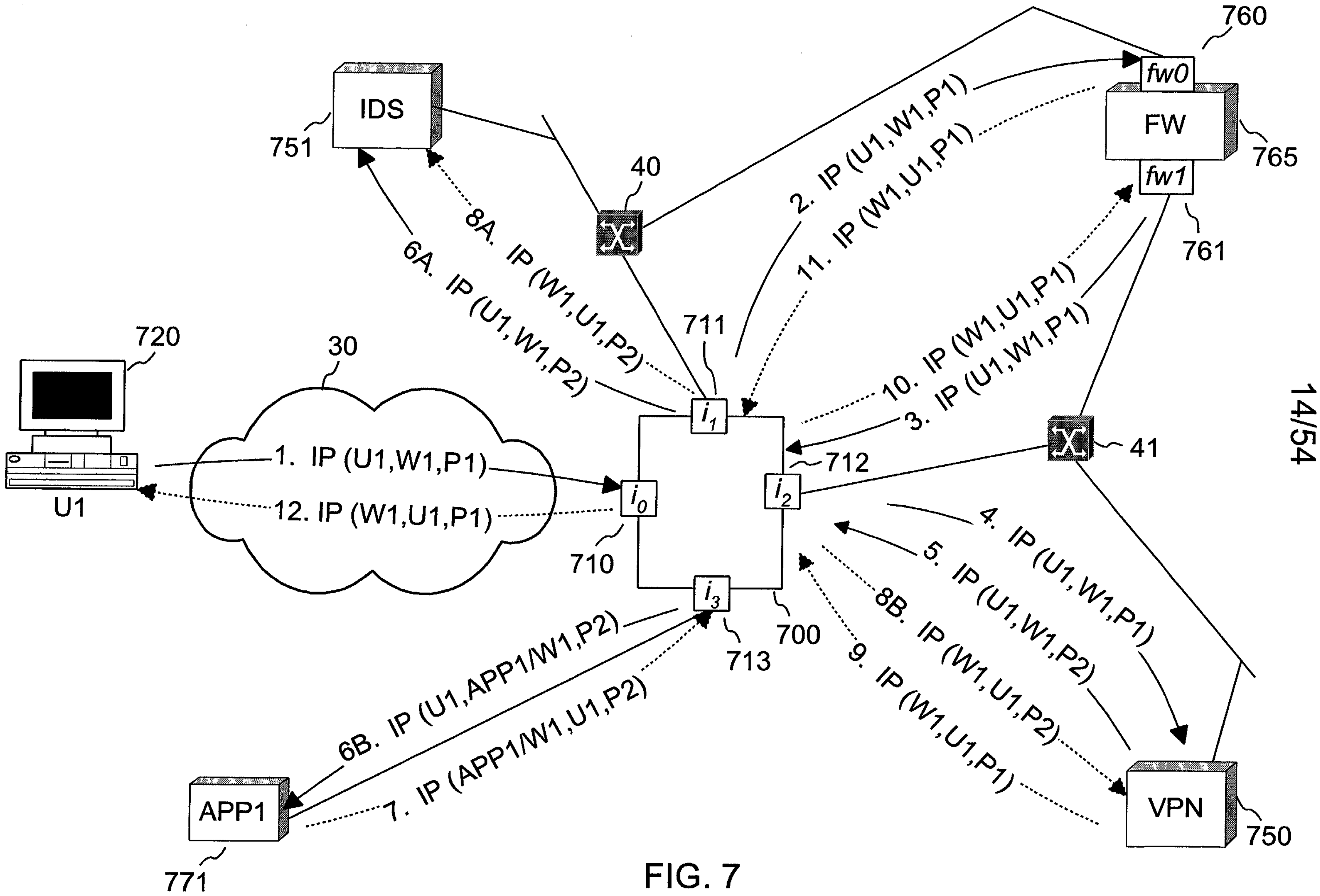

IDS
751
40
760
fw0
FW
765
fw1
761
720
30
U1
1. IP (U1,W1,P1)
12. IP (W1,U1,P1)
8A. IP (W1,U1,P2)
6A. IP (U1,W1,P2)
2. IP (U1,W1,P1)
11. IP (W1,U1,P1)
10. IP (W1,U1,P1)
3. IP (U1,W1,P1)
711
i_1
i_0
i_2
i_3
712
41
710
713
700
4. IP (U1,W1,P1)
5. IP (U1,W1,P2)
8B. IP (W1,U1,P2)
9. IP (W1,U1,P1)
6B. IP (U1,APP1/W1,P2)
7. IP (APP1/W1,U1,P2)
APP1
771
VPN
750

FIG. 7

731

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FW (INTERFACE FW0)	U1	W1	P1
3	FW (INTERFACE FW1)	PACKETING ENGINE	U1	W1	P1
4	PACKETING ENGINE	VPN	U1	W1	P1
5	VPN	PACKETING ENGINE	U1	W1	P2
6A	PACKETING ENGINE	IDS	U1	W1	P2
6B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	P2
7	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	P2
8A	PACKETING ENGINE	IDS	W1	U1	P2
8B	PACKETING ENGINE	VPN	W1	U1	P2
9	VPN	PACKETING ENGINE	W1	U1	P1
10	PACKETING ENGINE	FW (INTERFACE FW1)	W1	U1	P1
11	FW (INTERFACE FW0)	PACKETING ENGINE	W1	U1	P1
12	PACKETING ENGINE	U1	W1	U1	P1

FIG. 7A

TABLE MAINTAINED BY PACKETING ENGINE								
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA IINT.	DEST. SYSTEM TYPE	SEND PACKET TO	
	MAC	IP					MAC	IP
I_0			W1	P1	I_1	TRANSPARENT	$FW0_M$	W1
I_2	$FW1_M$		W1	P1	I_2	TRANSPARENT	VPN_M	W1
I_2	VPN_M		W1	P2	I_1	TRANSPARENT	IDS_M	W1
					I_3	LOOPBACK	$APP1_M$	W1
						ALIAS	$APP1_M$	W1
						NAT		APP1
I_1	IDS_M			P2	I_3	LOOPBACK	$APP1_M$	W1
						ALIAS	$APP1_M$	W1
						NAT		APP1
I_3	$APP1_M$	APP1 OR W1		P2	I_1	TRANSPARENT	IDS_M	
					I_2	TRANSPARENT	VPN_M	
I_2	VPN_M	W1		P1	I_2	TRANSPARENT	$FW1_M$	
I_1	$FW0_M$	W1		P1	I_0	ROUTER		DEFAULT ROUTE

732

FIG. 7B

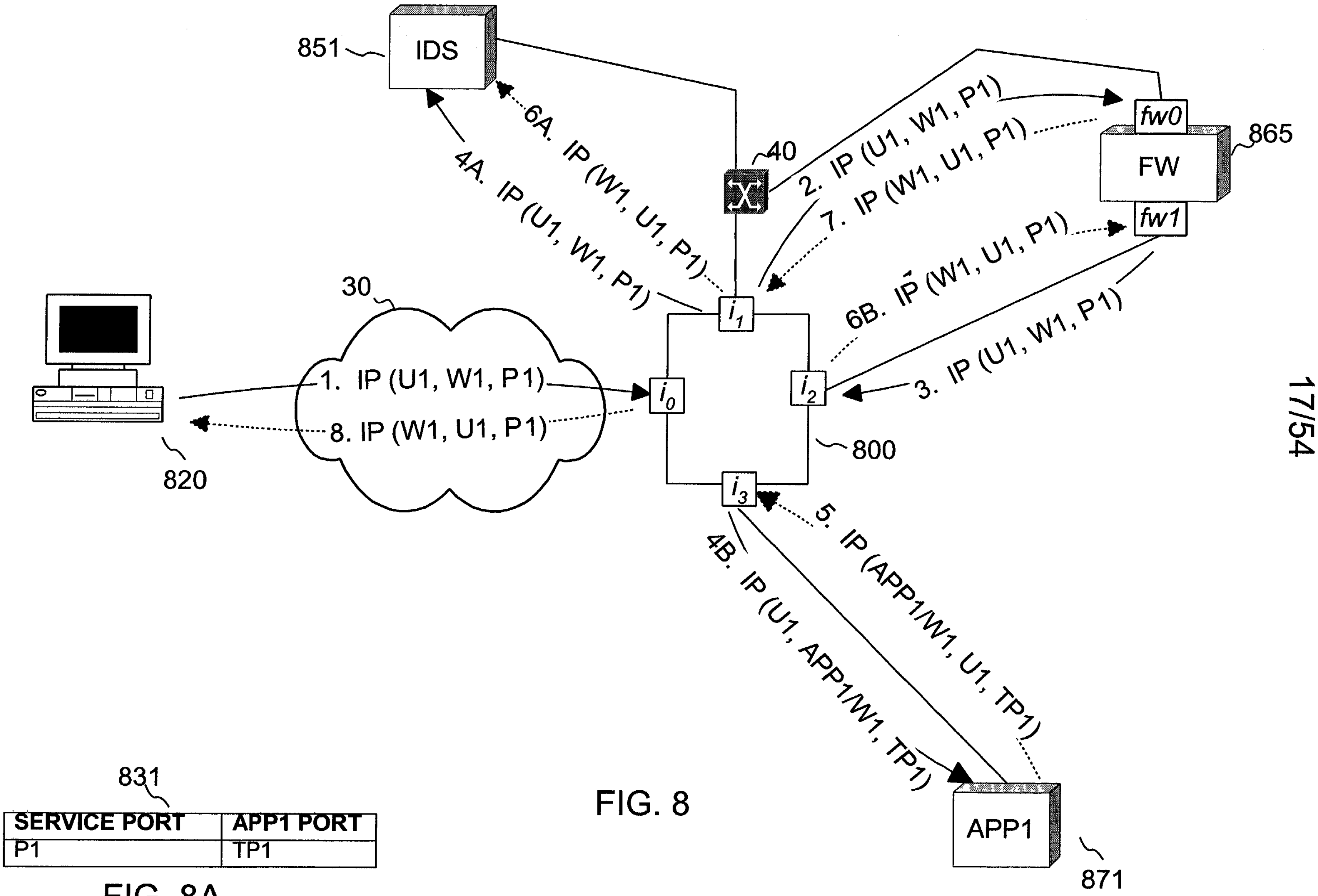


FIG. 8

831

SERVICE PORT	APP1 PORT
P1	TP1

FIG. 8A

STEP	FROM	TO	SOURCE IP	DESTINATION IP	SERVICE PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FW (INTERFACE FW0)	U1	W1	P1
3	FW (INTERFACE FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	TP1
5	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	TP1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	FW (INTERFACE FW1)	W1	U1	P1
7	FW (INTERFACE FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1

832

FIG. 8B

TABLE MAINTAINED BY PACKETING ENGINE									
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE				
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO		PORT
	MAC	IP					MAC	IP	
I_0	▨	▨	W1	P1	I_1	TRANSPARENT	$FW0_M$	W1	P1
I_2	FW_M	▨	W1	P1	I_1	TRANSPARENT	IDS_M	W1	P1
					I_3	LOOPBACK	$APP1_M$	W1	TP1
						ALIAS	$APP1_M$	W1	TP1
						NAT	▨	APP1	TP1
I_1	IDS_M	▨	▨	P1	I_3	LOOPBACK	$APP1_M$	W1	TP1
						ALIAS	$APP1_M$	W1	TP1
						NAT	▨	APP1	TP1
I_3	$APP1_M$	APP1 OR W1	▨	TP1	I_1	TRANSPARENT	IDS_M	▨	P1
					I_2	TRANSPARENT	$FW1_M$	▨	P1
I_1	FW_M	W1	▨	P1	I_0	ROUTER	▨	DEFAULT ROUTE	P1

833

FIG. 8C

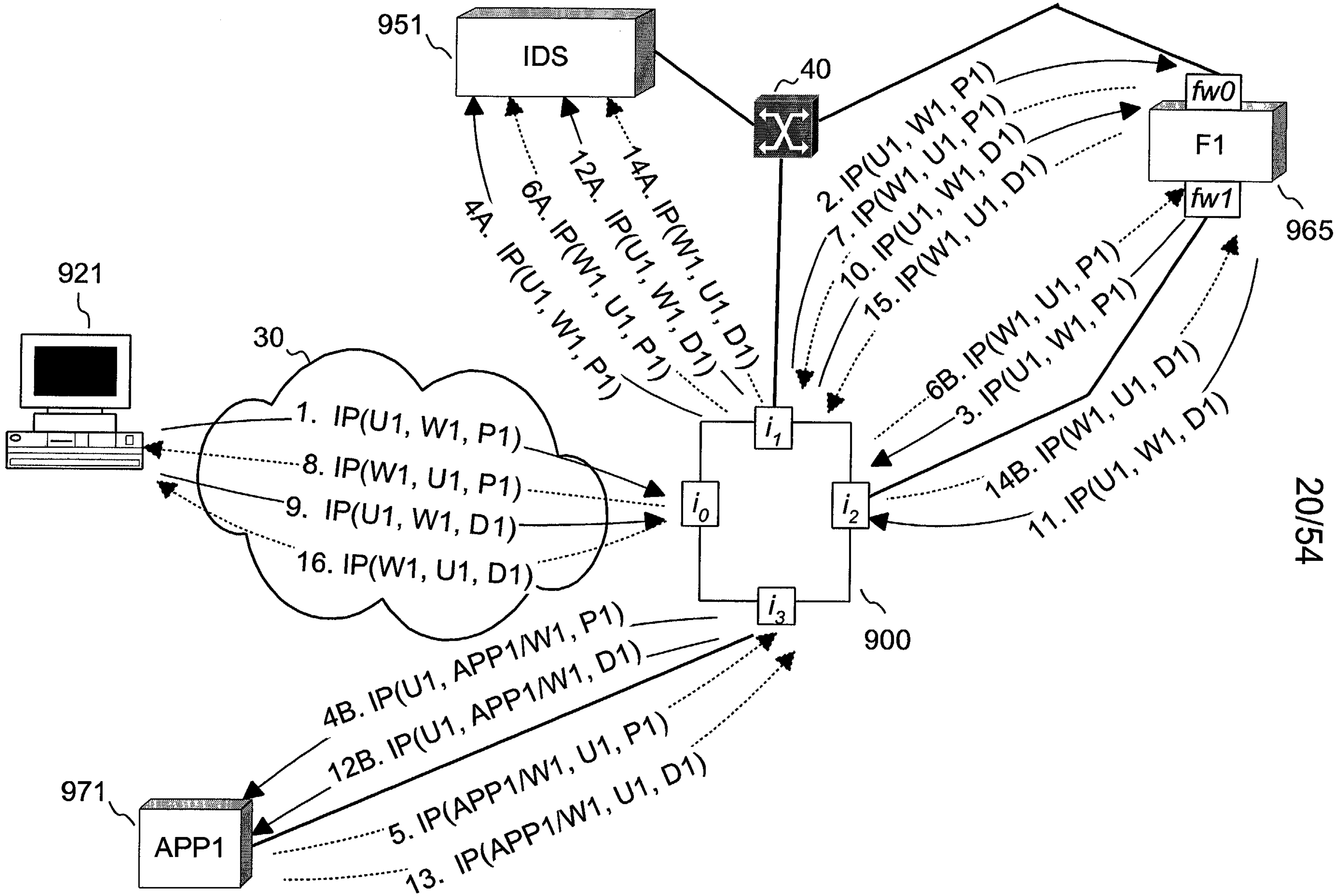

951
IDS
40
921
30
1. IP(U1, W1, P1)
8. IP(W1, U1, P1)
9. IP(U1, W1, D1)
16. IP(W1, U1, D1)
4A. IP(U1, W1, P1)
6A. IP(W1, U1, P1)
12A. IP(U1, W1, D1)
14A. IP(W1, U1, D1)
2. IP(U1, W1, P1)
7. IP(W1, U1, P1)
10. IP(U1, W1, D1)
15. IP(W1, U1, D1)
fw0
F1
fw1
965
6B. IP(W1, U1, P1)
3. IP(U1, W1, P1)
14B. IP(W1, U1, D1)
11. IP(U1, W1, D1)
i_1
i_0
i_2
i_3
900
4B. IP(U1, APP1/W1, P1)
12B. IP(U1, APP1/W1, D1)
5. IP(APP1/W1, U1, P1)
13. IP(APP1/W1, U1, D1)
971
APP1

FIG. 9

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	FIREWALL F1 (INT. FW0)	U1	W1	P1
3	FIREWALL F1 (INT. FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	P1
5	APP1	PACKETING ENGINE	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	U1	P1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	FIREWALL F1 (INT. FW1)	W1	U1	P1
7	FIREWALL F1 (INT. FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1
9	U1 (CLIENT)	PACKETING ENGINE	U1	W1	D1
10	PACKETING ENGINE	FIREWALL F1 (INT. FW0)	U1	W1	D1
11	FIREWALL F1 (INT. FW1)	PACKETING ENGINE	U1	W1	D1
12A	PACKETING ENGINE	IDS	U1	W1	D1
12B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	D1
13	APP1	PACKETING ENGINE	APP1 (IF NAT); W1 (IF LOOPBACK OR ALIAS)	U1	D1
14A	PACKETING ENGINE	IDS	W1	U1	D1
14B	PACKETING ENGINE	FIREWALL F1 (INT. FW1)	W1	U1	D1
15	FIREWALL F1 (INT. FW0)	PACKETING ENGINE	W1	U1	D1
16	PACKETING ENGINE	U1	W1	U1	D1

931

FIG. 9A

TABLES MAINTAINED BY PACKETING ENGINE								
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO	
	MAC	IP					MAC	IP
I_0			W1	P1 OR PORT IN RANGE OF 1025→1125	I_1	TRANSPARENT	$FW0_M$	W1
I_2	$FW1_M$		W1	P1 OR PORT IN RANGE OF 1025→1125	I_1	TRANSPARENT	IDS_M	W1
					I_3	LOOPBACK	$APP1_M$	W1
						ALIAS	$APP1_M$	W1
						NAT		APP1
I_1	IDS_M			P1 OR PORT IN RANGE OF 1025→1125	I_3	LOOPBACK	APP1	W1
						ALIAS	$APP1_M$	W1
						NAT		APP1
I_3	$APP1_M$	APP1 OR W1		P1 OR PORT IN RANGE OF 1025→1125	I_1	TRANSPARENT	IDS_M	
					I_2	TRANSPARENT	$FW1_M$	
I_1	$FW2_M$	W1		P1 OR PORT IN RANGE OF 1025→1125	I_0	ROUTER		DEFAULT ROUTE

932

FIG. 9B

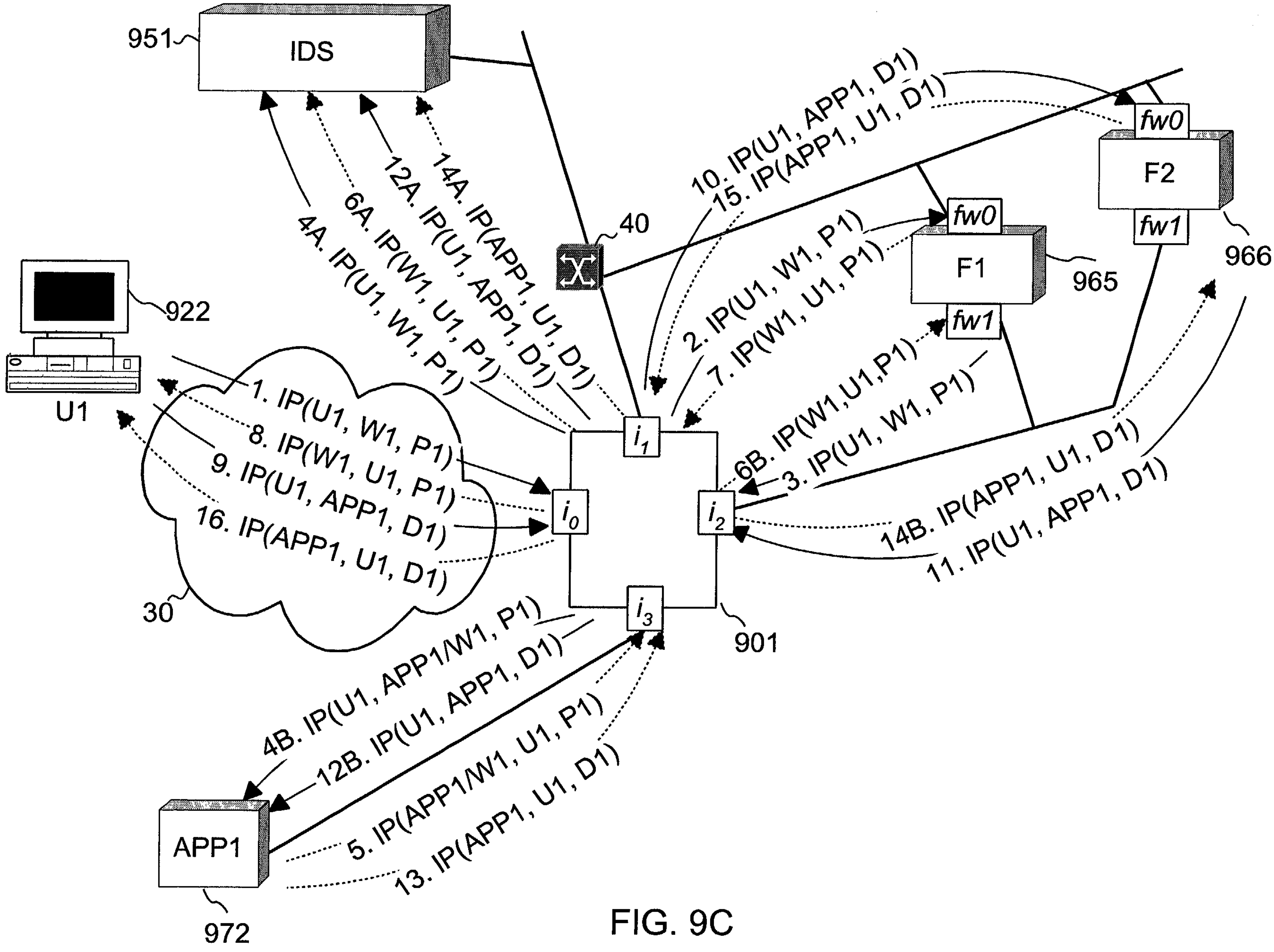

IDS
951
U1
922
30
40
F1
fw0
fw1
965
F2
fw0
fw1
966
APP1
972
901
i_0
i_1
i_2
i_3
1. IP(U1, W1, P1)
8. IP(W1, U1, P1)
9. IP(U1, APP1, D1)
16. IP(APP1, U1, D1)
4A. IP(U1, W1, P1)
6A. IP(W1, U1, P1)
12A. IP(U1, APP1, D1)
14A. IP(APP1, U1, D1)
10. IP(U1, APP1, D1)
15. IP(APP1, U1, D1)
2. IP(U1, W1, P1)
7. IP(W1, U1, P1)
6B. IP(W1,U1,P1)
3. IP(U1, W1, P1)
14B. IP(APP1, U1, D1)
11. IP(U1, APP1, D1)
4B. IP(U1, APP1/W1, P1)
12B. IP(U1, APP1, D1)
5. IP(APP1/W1, U1, P1)
13. IP(APP1, U1, D1)

FIG. 9C

STEP	FROM	TO	SOURCE IP	DESTINATION IP	PORT
1	U1 (CLIENT)	PACKETING ENGINE	U1	W1	P1
2	PACKETING ENGINE	F1 (INT. FW0)	U1	W1	P1
3	F1 (INT. FW1)	PACKETING ENGINE	U1	W1	P1
4A	PACKETING ENGINE	IDS	U1	W1	P1
4B	PACKETING ENGINE	APP1	U1	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	P1
5	APP1	PACKETING ENGINE	APP1 (IF NAT REQUIRED); W1 (IF LOOPBACK OR ALIAS SUPPORTED BY APP1)	U1	P1
6A	PACKETING ENGINE	IDS	W1	U1	P1
6B	PACKETING ENGINE	F1 (INT. FW1)	W1	U1	P1
7	F1 (INT. FW0)	PACKETING ENGINE	W1	U1	P1
8	PACKETING ENGINE	U1	W1	U1	P1
9	U1 (CLIENT)	PACKETING ENGINE	U1	APP1	D1
10	PACKETING ENGINE	F2 (INT. FW0)	U1	APP1	D1
11	F2 (INT. FW1)	PACKETING ENGINE	U1	APP1	D1
12A	PACKETING ENGINE	IDS	U1	APP1	D1
12B	PACKETING ENGINE	APP1	U1	APP1	D1
13	APP1	PACKETING ENGINE	APP1	U1	D1
14A	PACKETING ENGINE	IDS	APP1	U1	D1
14B	PACKETING ENGINE	F2 (INT. FW1)	APP1	U1	D1
15	F2 (INT. FW0)	PACKETING ENGINE	APP1	U1	D1
16	PACKETING ENGINE	U1	APP1	U1	D1

934

FIG. 9D

TABLES MAINTAINED BY PACKETING ENGINE								
RECEIVE PACKET INBOUND TO PACKETING ENGINE					SEND IT OUTBOUND FROM PACKETING ENGINE			
RCX ON INT.	SOURCE ADDRESS		DEST. IP ADDRESS	SERVICE PORT	SEND VIA INT.	DEST. SYSTEM TYPE	SEND PACKET TO	
	MAC	IP					MAC	IP
I_0	▨	▨	W1	P1	I_1	TRANSPARENT	$F1(FW0)_M$	W1
I_2	$F1(FW1)_M$	▨	W1	P1	I_1	TRANSPARENT	IDS_M	W1
					I_3	LOOPBACK	$APP1_M$	W1
						ALIAS	$APP1_M$	W1
						NAT	▨	APP1
I_1	IDS_M	▨	▨	P1	I_3	LOOPBACK	$APP1_M$	W1
						ALIAS	$APP1_M$	W1
						NAT	▨	APP1
I_3	$APP1_M$	APP1 OR W1	▨	P1	I_1	TRANSPARENT	IDS_M	▨
					I_2	TRANSPARENT	$F1(FW1)_M$	▨
I_1	$F1(FW0)_M$	W1	▨	P1	I_0	ROUTER	▨	DEFAULT ROUTE
I_0	▨	▨	APP1	PORT>1024	I_1	TRANSPARENT	$F2(FW0)_M$	APP1
I_2	$F2(FW1)_M$	▨	APP1	PORT>1024	I_1	TRANSPARENT	IDS_M	APP1
					I_3	SERVER IP ADDRESS	$APP1_M$	APP1
I_1	IDS_M	▨	▨	PORT>1024	I_3	SERVER IP ADDRESS	$APP1_M$	APP1
I_3	$APP1_M$	APP1	▨	PORT>1024	I_1	TRANSPARENT	IDS_M	▨
					I_2	TRANSPARENT	$F2(FW1)_M$	▨
I_1	$F2(FW0)_M$	APP1	▨	PORT>1024	I_0	ROUTER	▨	DEFAULT ROUTE

935

FIG. 9E

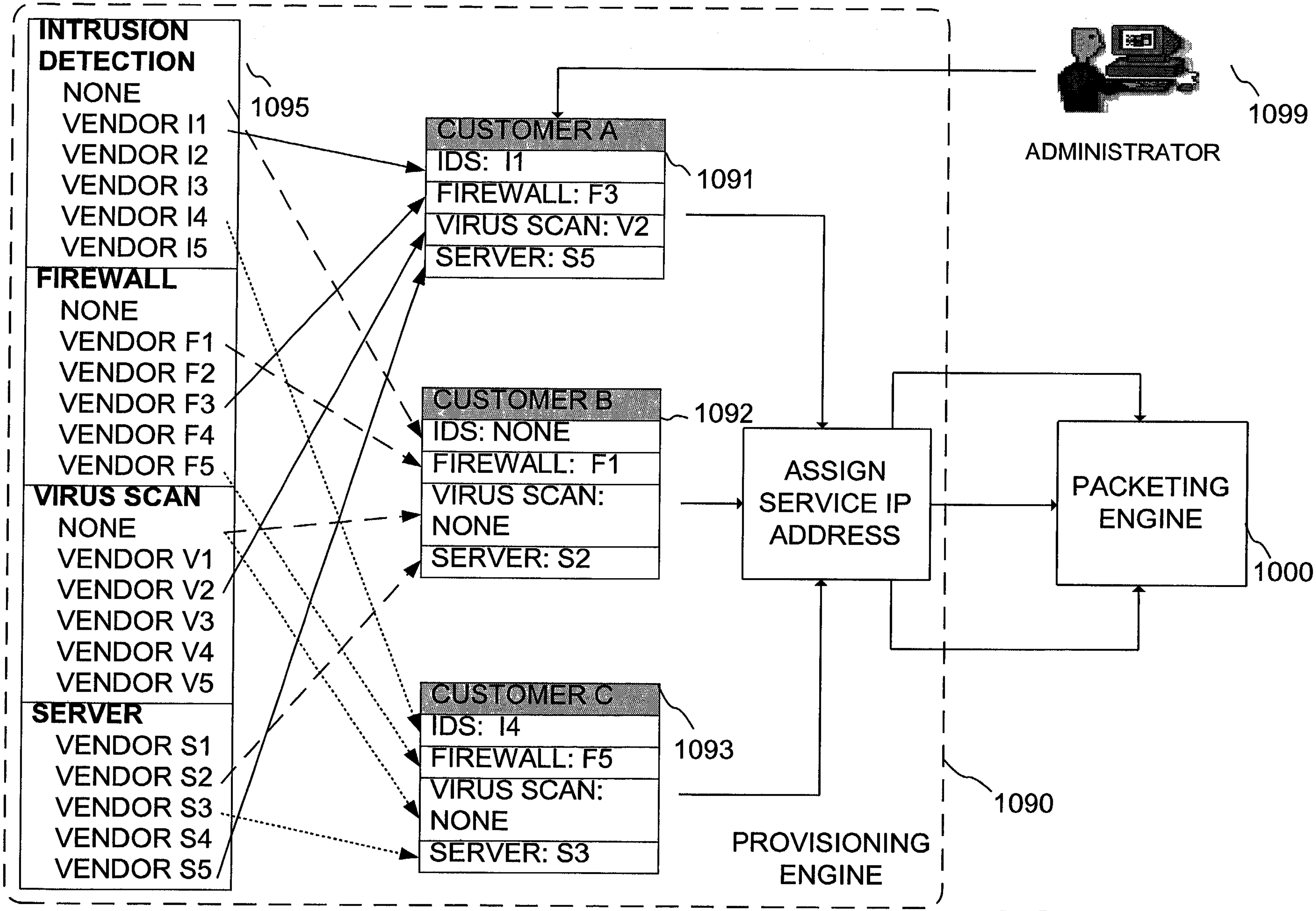

INTRUSION DETECTION
NONE
VENDOR I1
VENDOR I2
VENDOR I3
VENDOR I4
VENDOR I5
FIREWALL
NONE
VENDOR F1
VENDOR F2
VENDOR F3
VENDOR F4
VENDOR F5
VIRUS SCAN
NONE
VENDOR V1
VENDOR V2
VENDOR V3
VENDOR V4
VENDOR V5
SERVER
VENDOR S1
VENDOR S2
VENDOR S3
VENDOR S4
VENDOR S5
1095
CUSTOMER A
IDS: I1
FIREWALL: F3
VIRUS SCAN: V2
SERVER: S5
1091
CUSTOMER B
IDS: NONE
FIREWALL: F1
VIRUS SCAN: NONE
SERVER: S2
1092
CUSTOMER C
IDS: I4
FIREWALL: F5
VIRUS SCAN: NONE
SERVER: S3
1093
ASSIGN SERVICE IP ADDRESS
PROVISIONING ENGINE
1090
ADMINISTRATOR
1099
PACKETING ENGINE
1000

FIG. 10

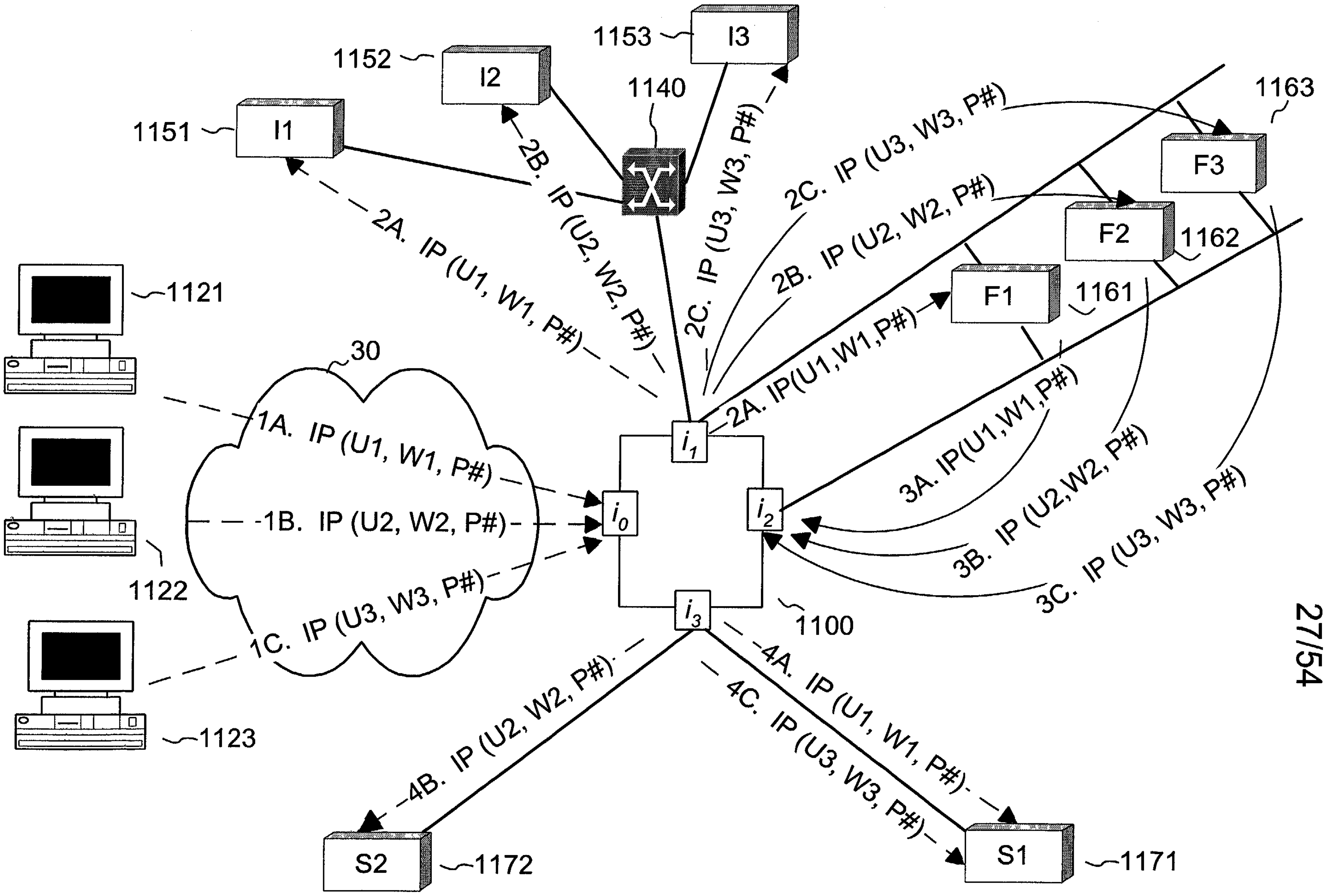

1151
I1
1152
I2
1153
I3
1140
1163
F3
F2
1162
F1
1161
1121
1122
1123
30
1A. IP (U1, W1, P#)
1B. IP (U2, W2, P#)
1C. IP (U3, W3, P#)
2A. IP (U1, W1, P#)
2B. IP (U2, W2, P#)
2C. IP (U3, W3, P#)
2C. IP (U3, W3, P#)
2B. IP (U2, W2, P#)
2A. IP(U1,W1,P#)
3A. IP(U1,W1,P#)
3B. IP (U2,W2, P#)
3C. IP (U3, W3, P#)
i_1
i_0
i_2
i_3
1100
4A. IP (U1, W1, P#)
4B. IP (U2, W2, P#)
4C. IP (U3, W3, P#)
S2
1172
S1
1171

FIG. 11

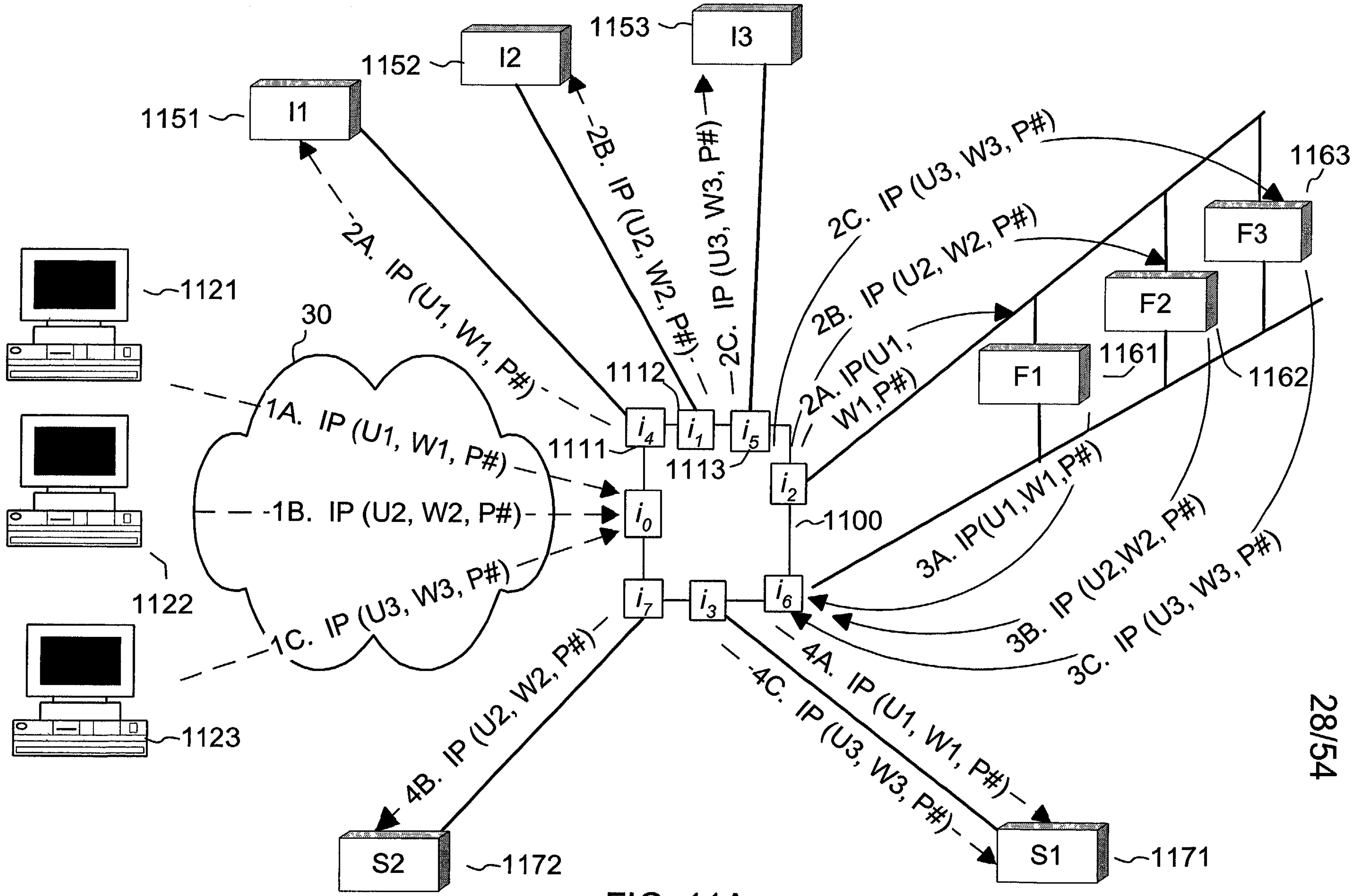

1151
I1
1152
I2
1153
I3
1121
1122
1123
30
1A. IP (U1, W1, P#)
1B. IP (U2, W2, P#)
1C. IP (U3, W3, P#)
2A. IP (U1, W1, P#)
2B. IP (U2, W2, P#)
2C. IP (U3, W3, P#)
2A. IP(U1, W1,P#)
2B. IP (U2, W2, P#)
2C. IP (U3, W3, P#)
1112
1111
1113
i_4
i_1
i_5
i_2
i_0
i_7
i_3
i_6
1100
F1
F2
F3
1161
1162
1163
3A. IP(U1,W1,P#)
3B. IP (U2,W2, P#)
3C. IP (U3, W3, P#)
4A. IP (U1, W1, P#)
4B. IP (U2, W2, P#)
4C. IP (U3, W3, P#)
S1
1171
S2
1172

FIG. 11A

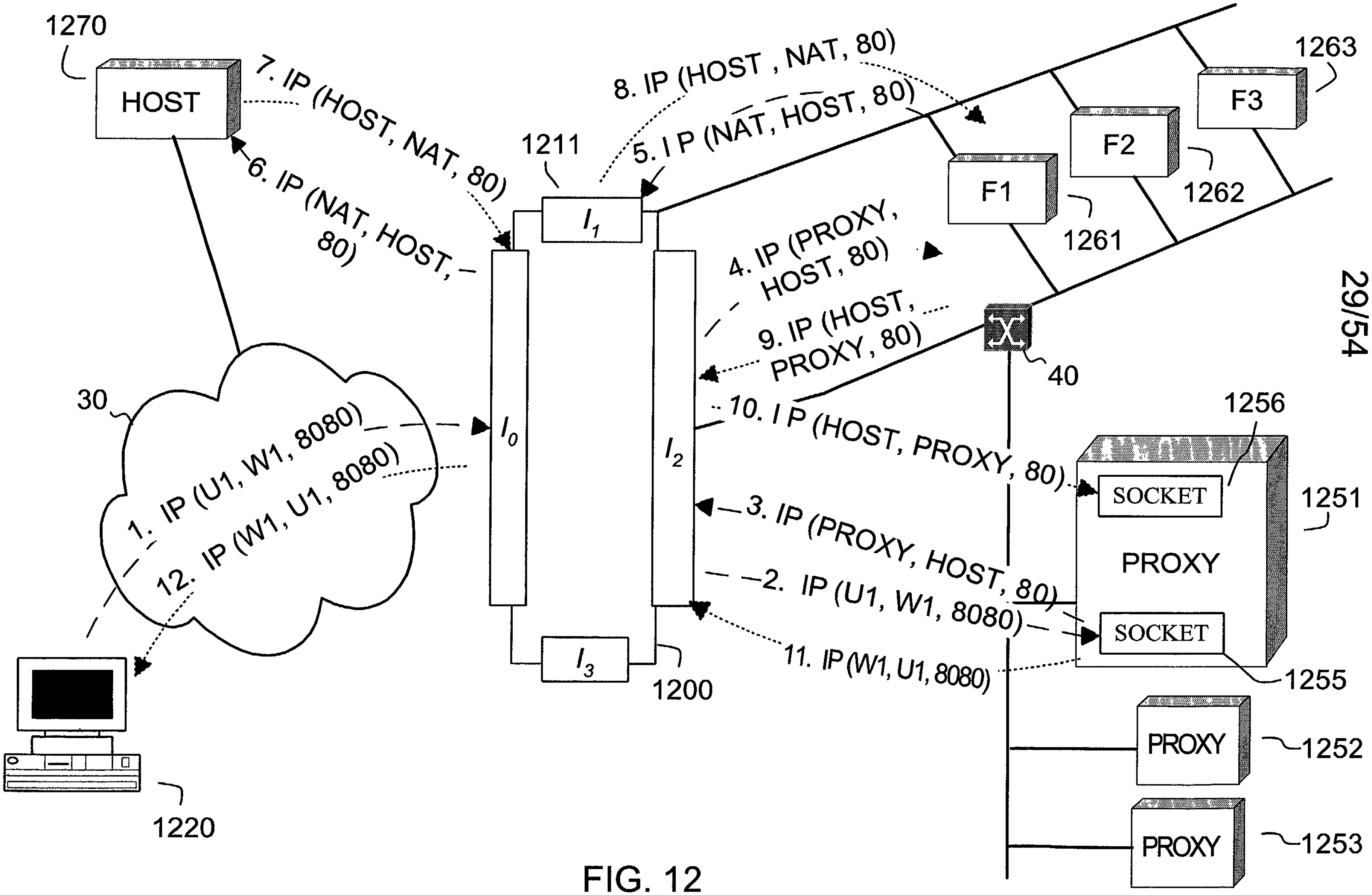

1270
HOST
7. IP (HOST, NAT, 80)
6. IP (NAT, HOST, 80)
1211
I1
8. IP (HOST , NAT, 80)
5. I P (NAT, HOST, 80)
F1
F2
F3
1261
1262
1263
4. IP (PROXY, HOST, 80)
9. IP (HOST, PROXY, 80)
40
10. I P (HOST, PROXY, 80)
3. IP (PROXY, HOST, 80)
2. IP (U1, W1, 8080)
11. IP (W1, U1, 8080)
I0
I2
I3
1200
30
1. IP (U1, W1, 8080)
12. IP (W1, U1, 8080)
1220
1256
SOCKET
PROXY
SOCKET
1251
1255
PROXY
1252
PROXY
1253

FIG. 12

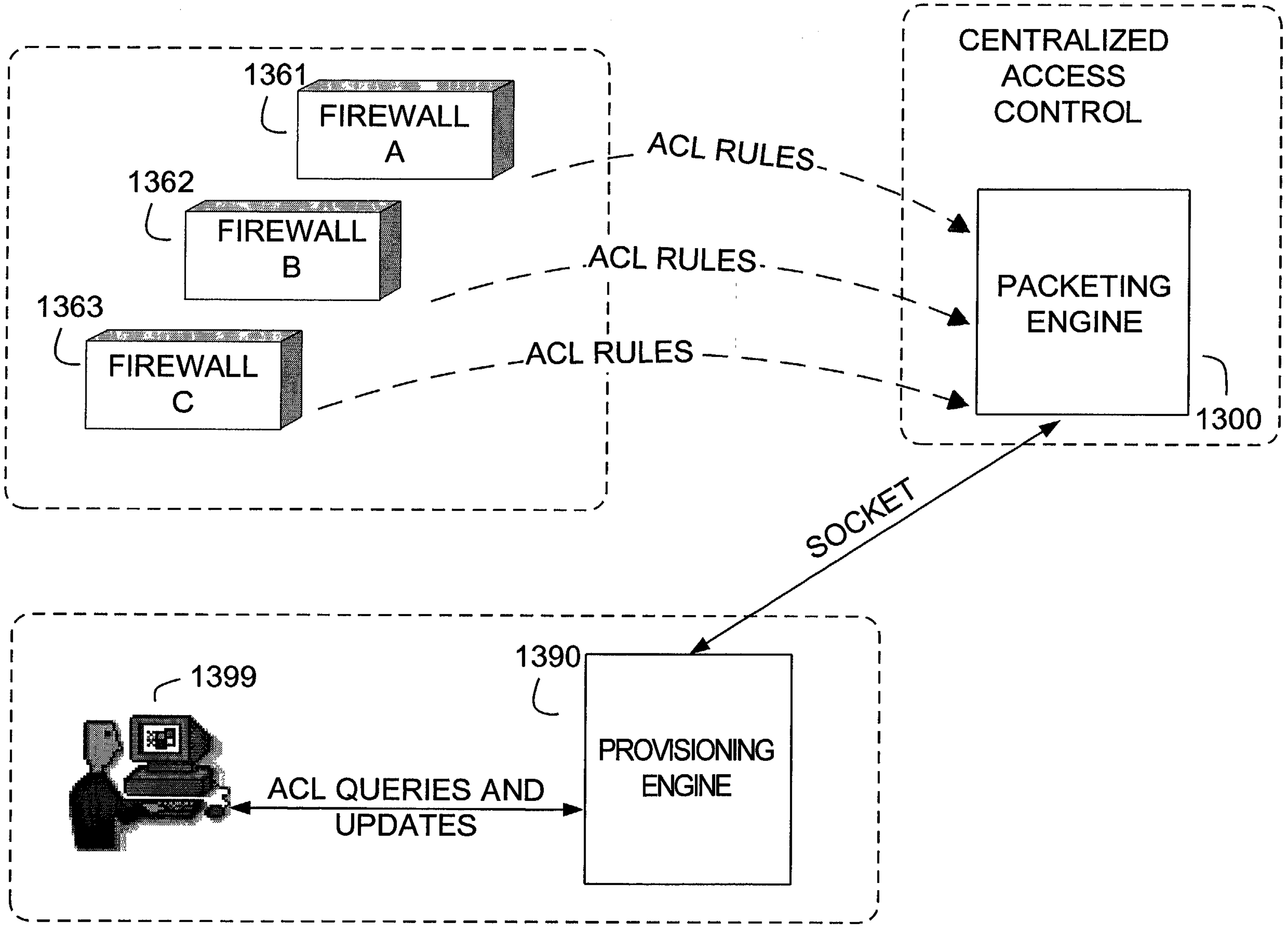

1361
FIREWALL
A
1362
FIREWALL
B
1363
FIREWALL
C
ACL RULES
ACL RULES
ACL RULES
CENTRALIZED
ACCESS
CONTROL
PACKETING
ENGINE
1300
SOCKET
1390
PROVISIONING
ENGINE
1399
ACL QUERIES AND
UPDATES

FIG. 13

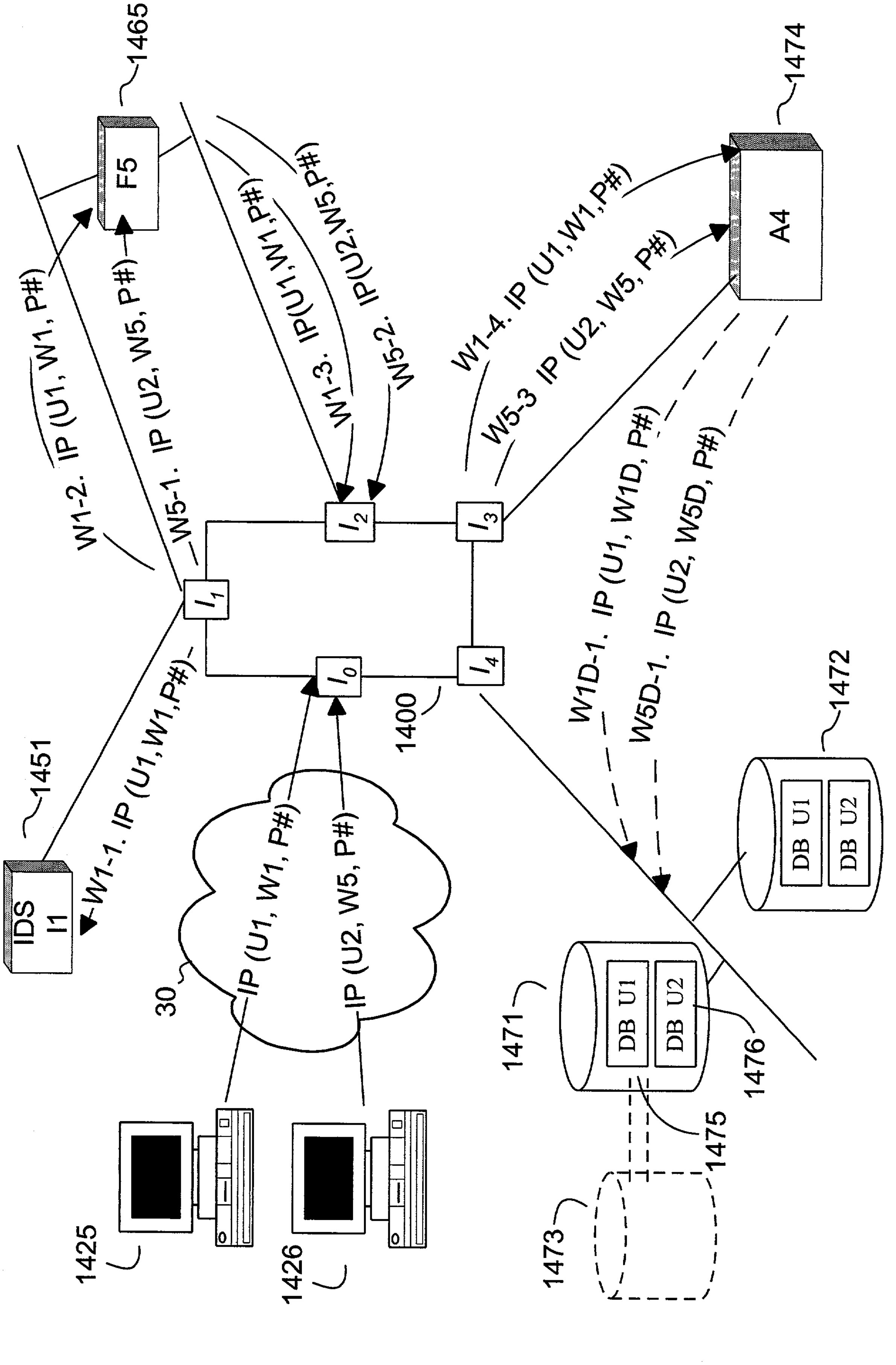

1465
F5
1474
A4
W1-2. IP (U1, W1, P#)
W5-1. IP (U2, W5, P#)
W1-3. IP(U1,W1,P#)
W5-2. IP(U2,W5,P#)
W1-4. IP (U1,W1,P#)
W5-3 IP (U2, W5, P#)
I_1
I_2
I_3
I_4
I_0
1400
1451
IDS
I1
W1-1. IP (U1,W1,P#)
W1D-1. IP (U1, W1D, P#)
W5D-1. IP (U2, W5D, P#)
1472
DB U1
DB U2
30
IP (U1, W1, P#)
IP (U2, W5, P#)
1471
1476
1475
1473
1425
1426

FIG. 14

SERVICE IP ADDRESS W1

STEP W1-1	INTRUSION DETECTION	I1
STEP W1-2/3	FIREWALL	F5
STEP W1-4	APPLICATION SERVER	A4

1431

FIG. 14A

SERVICE IP ADDRESS W5

STEP W5-1/2	FIREWALL	F5
STEP W5-3	APPLICATION SERVER	A4

1432

FIG. 14B

SERVICE IP ADDRESS W1D

STEP W1D-1	DATABASE SERVER	D1

1433

FIG. 14C

SERVICE IP ADDRESS W5D

STEP W5D-1	DATABASE SERVER	D1

1434

FIG. 14D

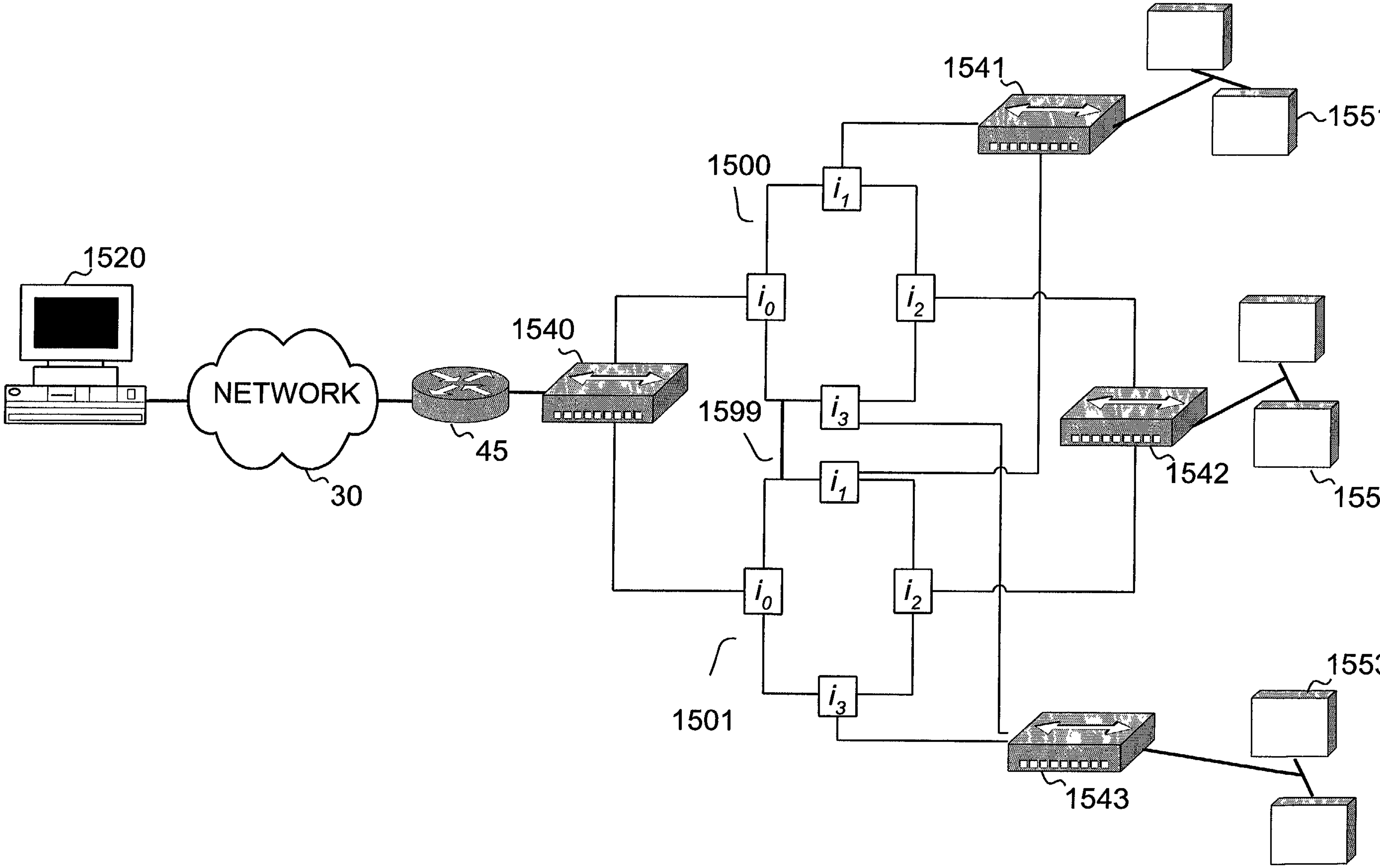

1520
NETWORK
30
45
1540
1500
i_1
i_0
i_2
i_3
1599
i_1
i_0
i_2
i_3
1501
1541
1551
1542
1552
1543
1553

FIG. 15

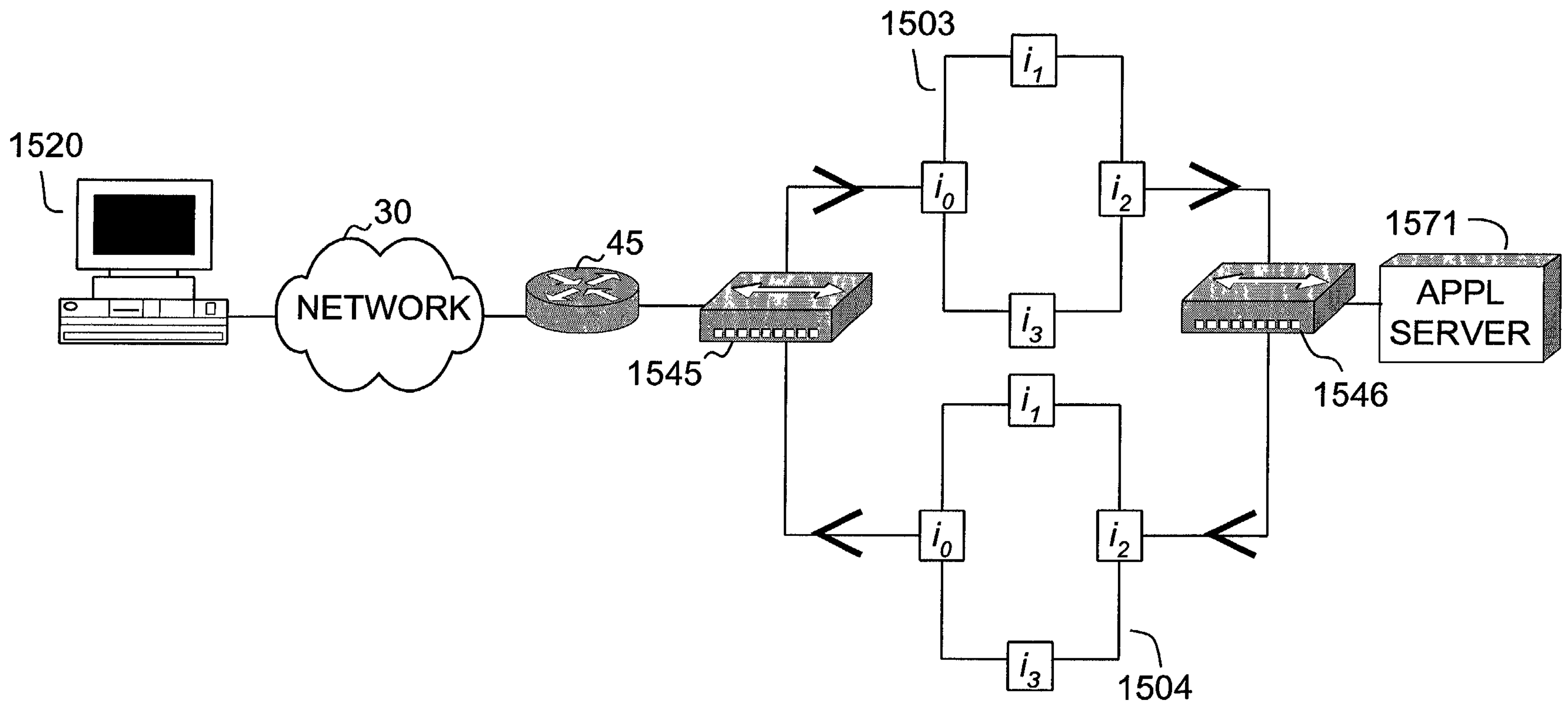

1520
30
NETWORK
45
1545
1503
i_0
i_1
i_2
i_3
i_0
i_1
i_2
i_3
1504
1546
1571
APPL
SERVER

FIG. 15A

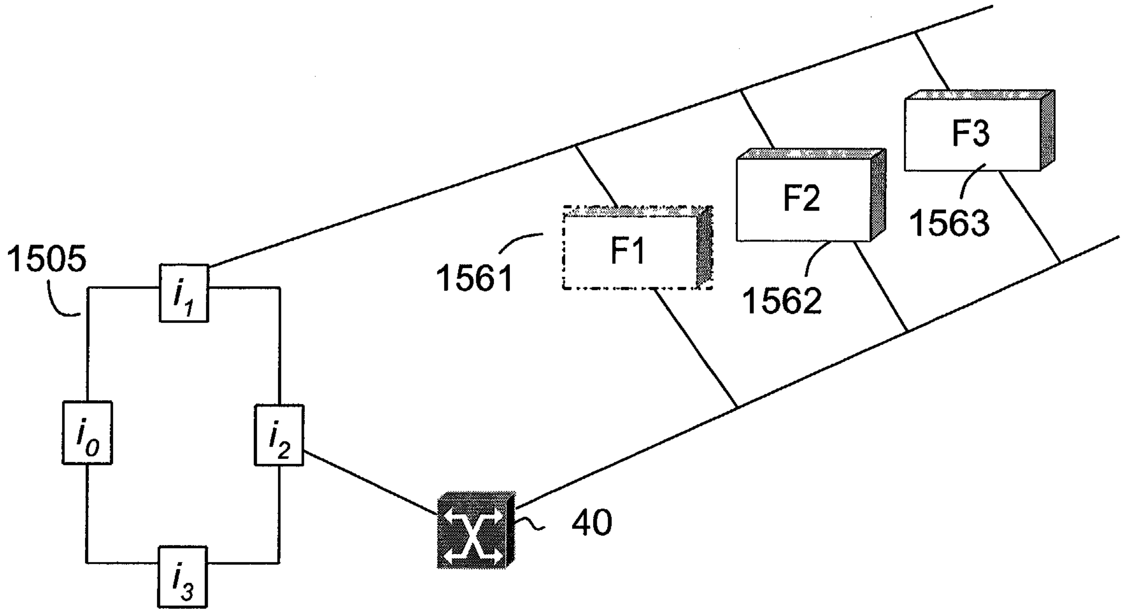


FIG. 15B

SEND IT OUTBOUND FROM PACKETING ENGINE			
SEND FROM INTERFACE	DEST. SYSTEM TYPE	SEND PACKET TO	
		MAC	IP
I_1	TRANSPARENT	FIREWALL $F1_M$	W1
I_1	TRANSPARENT	FIREWALL $F2_M$	W1

FIG. 15C

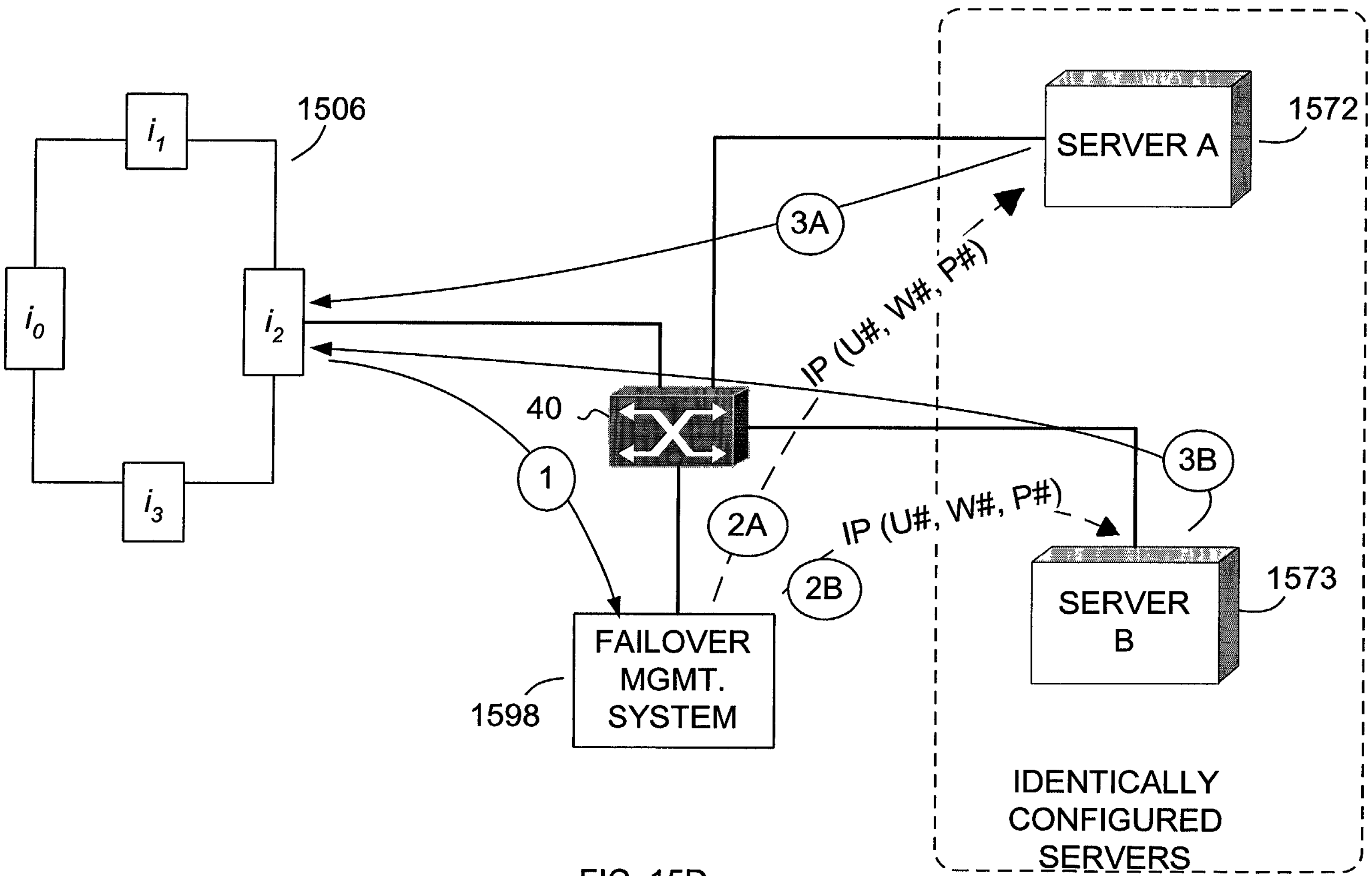

1506
i_1
i_0
i_2
i_3
40
1
FAILOVER MGMT. SYSTEM
1598
2A
2B
3A
3B
IP (U#, W#, P#)
IP (U#, W#, P#)
SERVER A
1572
SERVER B
1573
IDENTICALLY CONFIGURED SERVERS

FIG. 15D

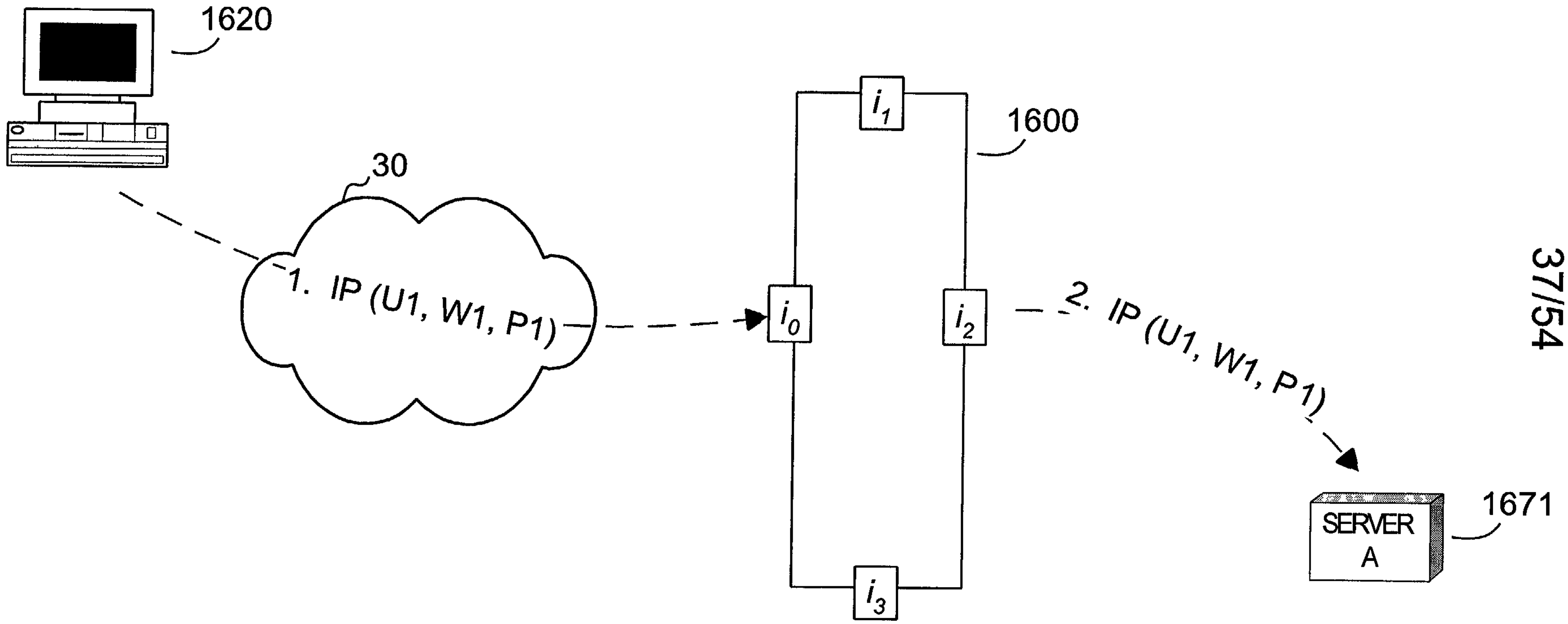


FIG. 16

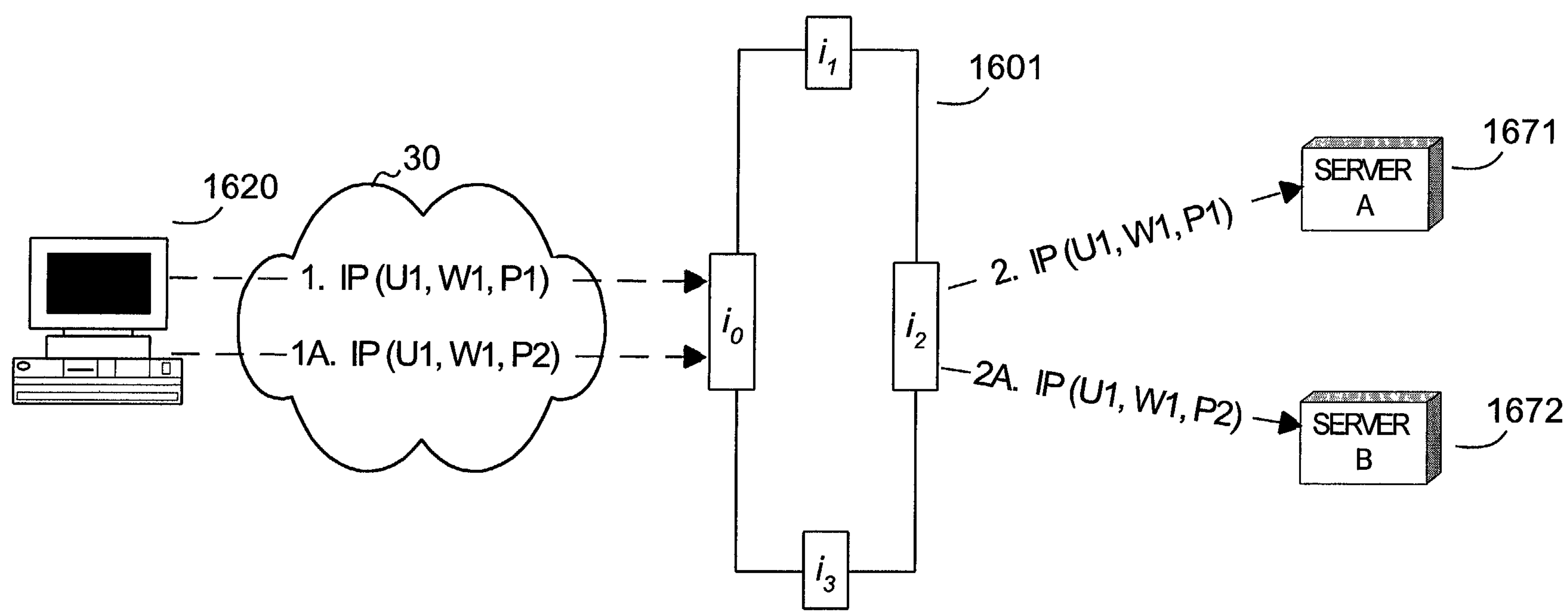

1620
30
1. IP (U1, W1, P1)
1A. IP (U1, W1, P2)
i_0
i_1
i_2
i_3
1601
2. IP (U1, W1, P1)
2A. IP (U1, W1, P2)
SERVER A
1671
SERVER B
1672

FIG. 16A

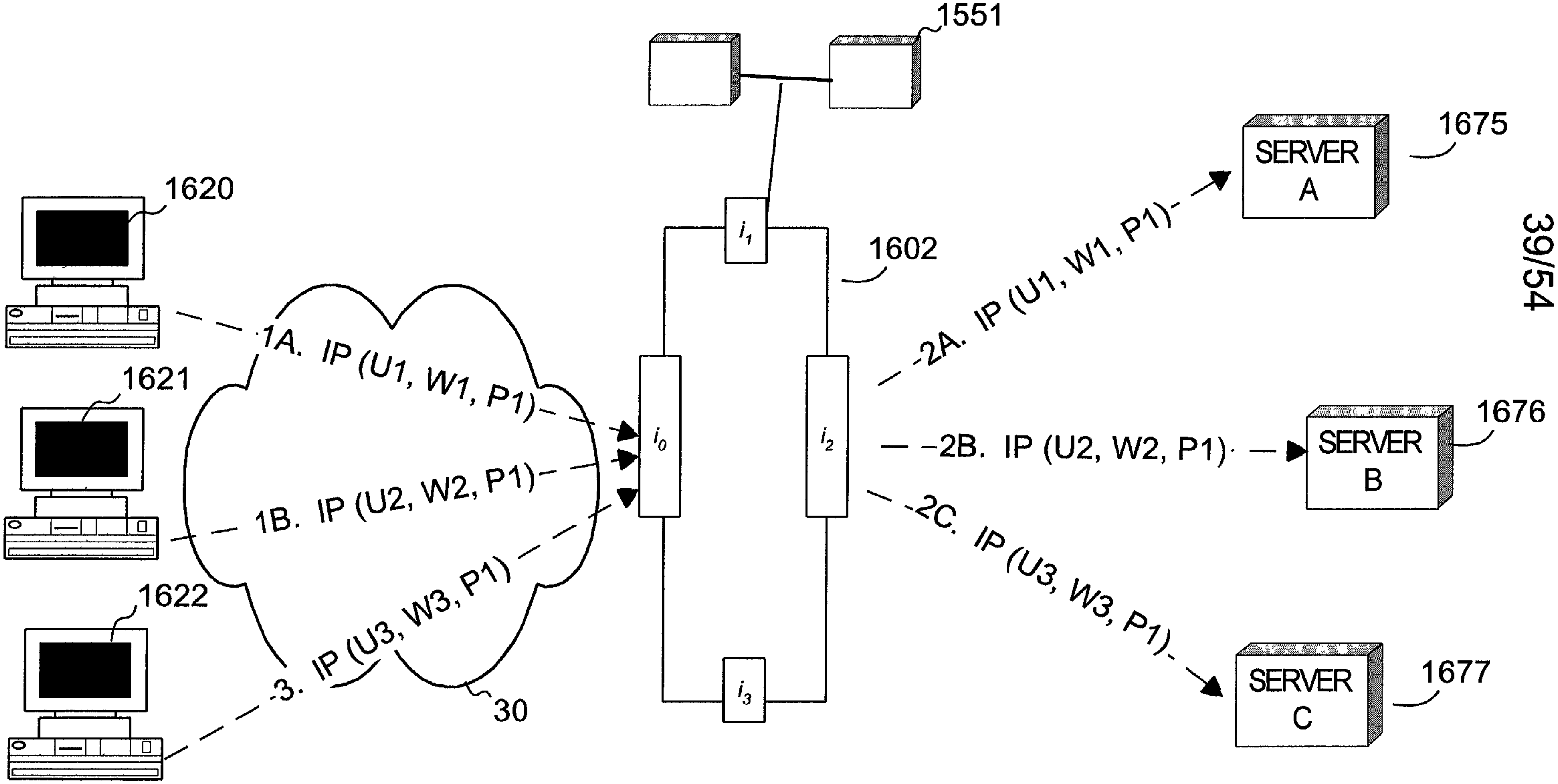

1551
1675
SERVER A
1620
1602
1A. IP (U1, W1, P1)
-2A. IP (U1, W1, P1)
1621
i_1
i_0
i_2
i_3
-2B. IP (U2, W2, P1)
1676
SERVER B
1B. IP (U2, W2, P1)
1622
3. IP (U3, W3, P1)
30
-2C. IP (U3, W3, P1)
1677
SERVER C

FIG. 16B

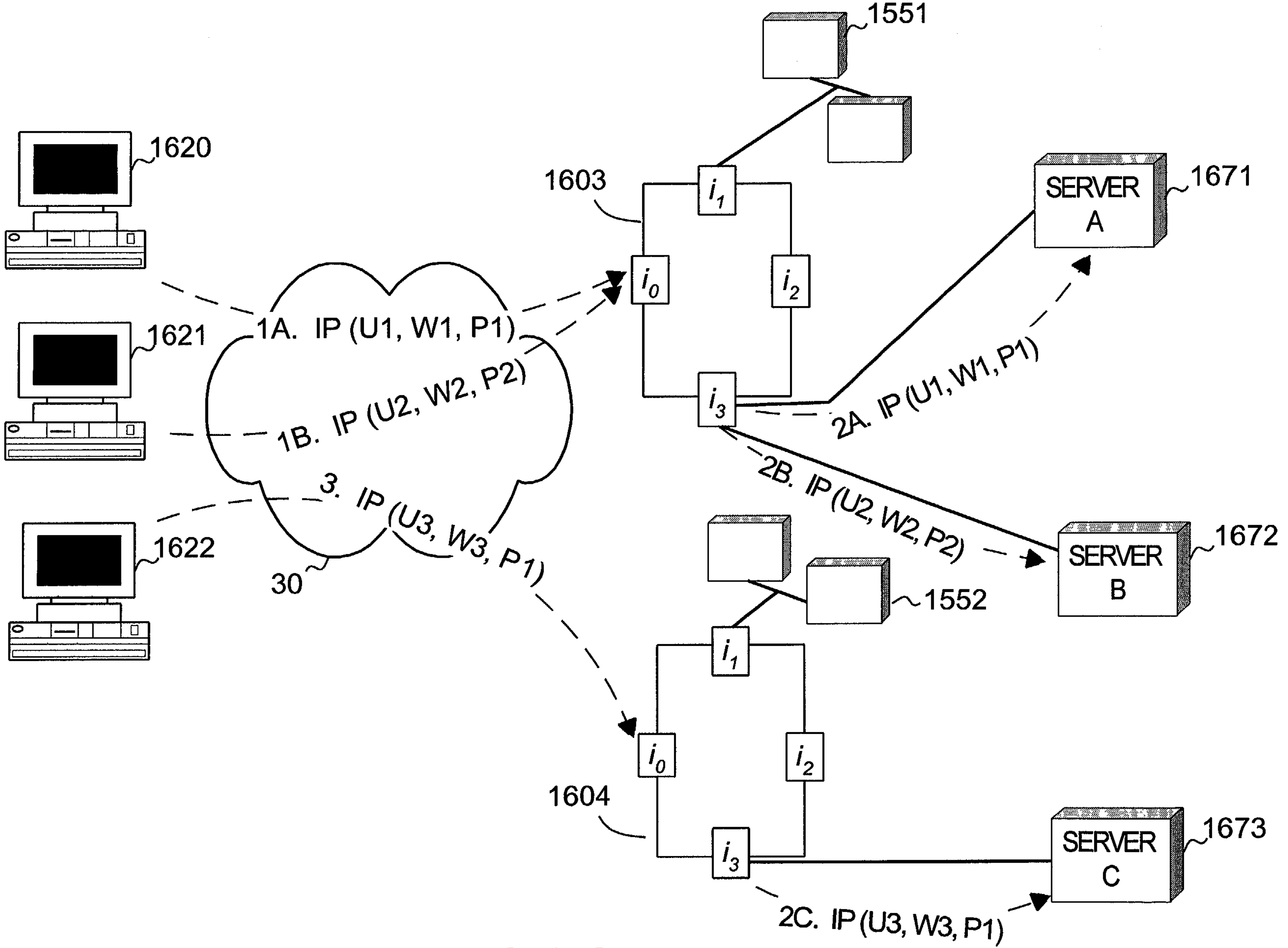

1551
1620
1603
1671
SERVER A
1621
1A. IP (U1, W1, P1)
1B. IP (U2, W2, P2)
2A. IP (U1, W1, P1)
2B. IP (U2, W2, P2)
1622
3. IP (U3, W3, P1)
30
1672
SERVER B
1552
1604
1673
SERVER C
2C. IP (U3, W3, P1)
i_0
i_1
i_2
i_3

FIG. 16C

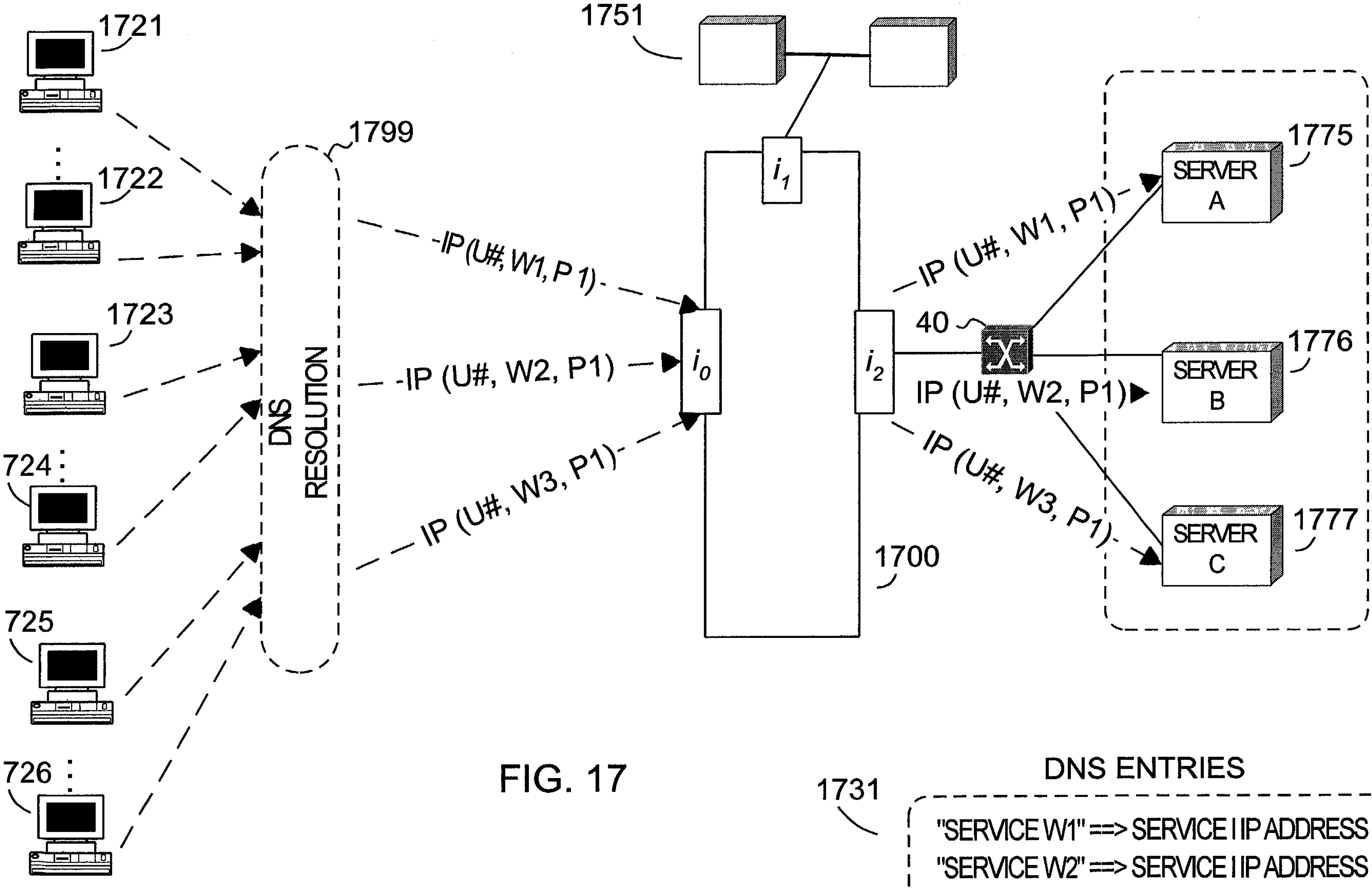


FIG. 17

DNS ENTRIES

"SERVICE W1" ==> SERVICE I IP ADDRESS W1
"SERVICE W2" ==> SERVICE I IP ADDRESS W2
"SERVICE W3" ==> SERVICE I IP ADDRESS W3

FIG. 17A

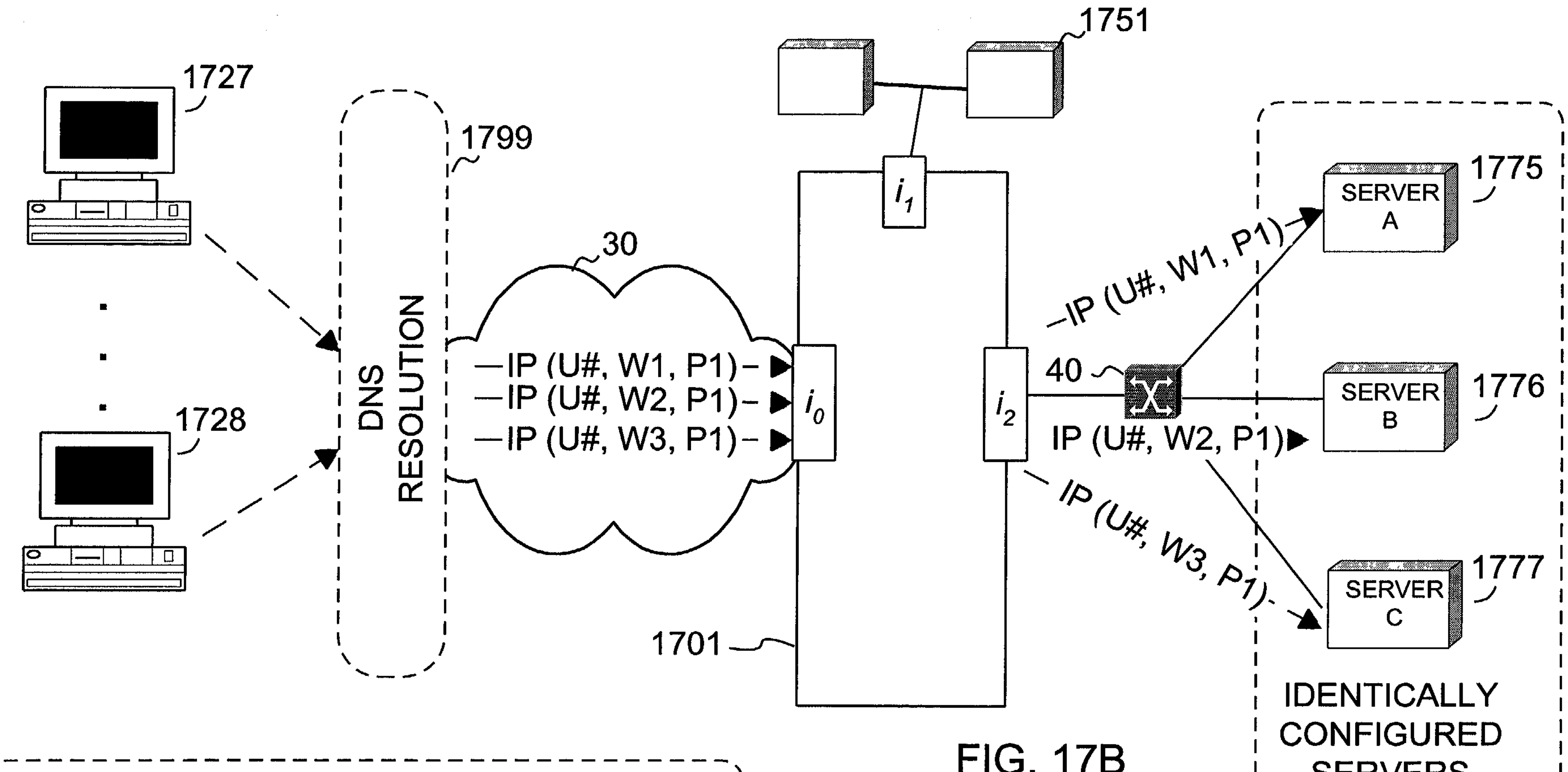


FIG. 17B

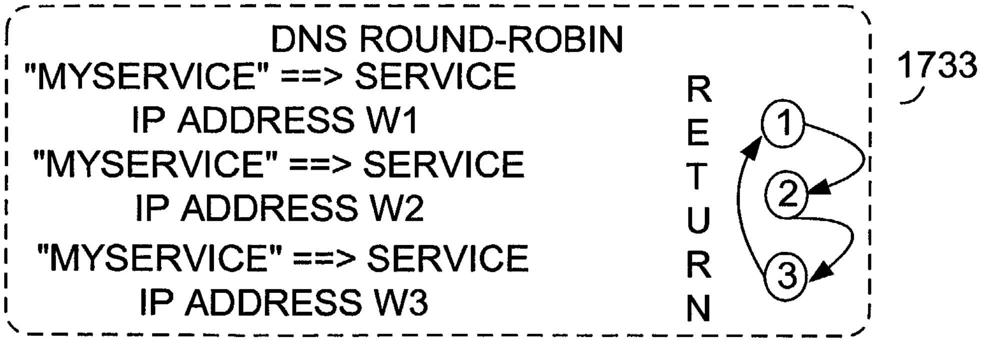


FIG. 17C

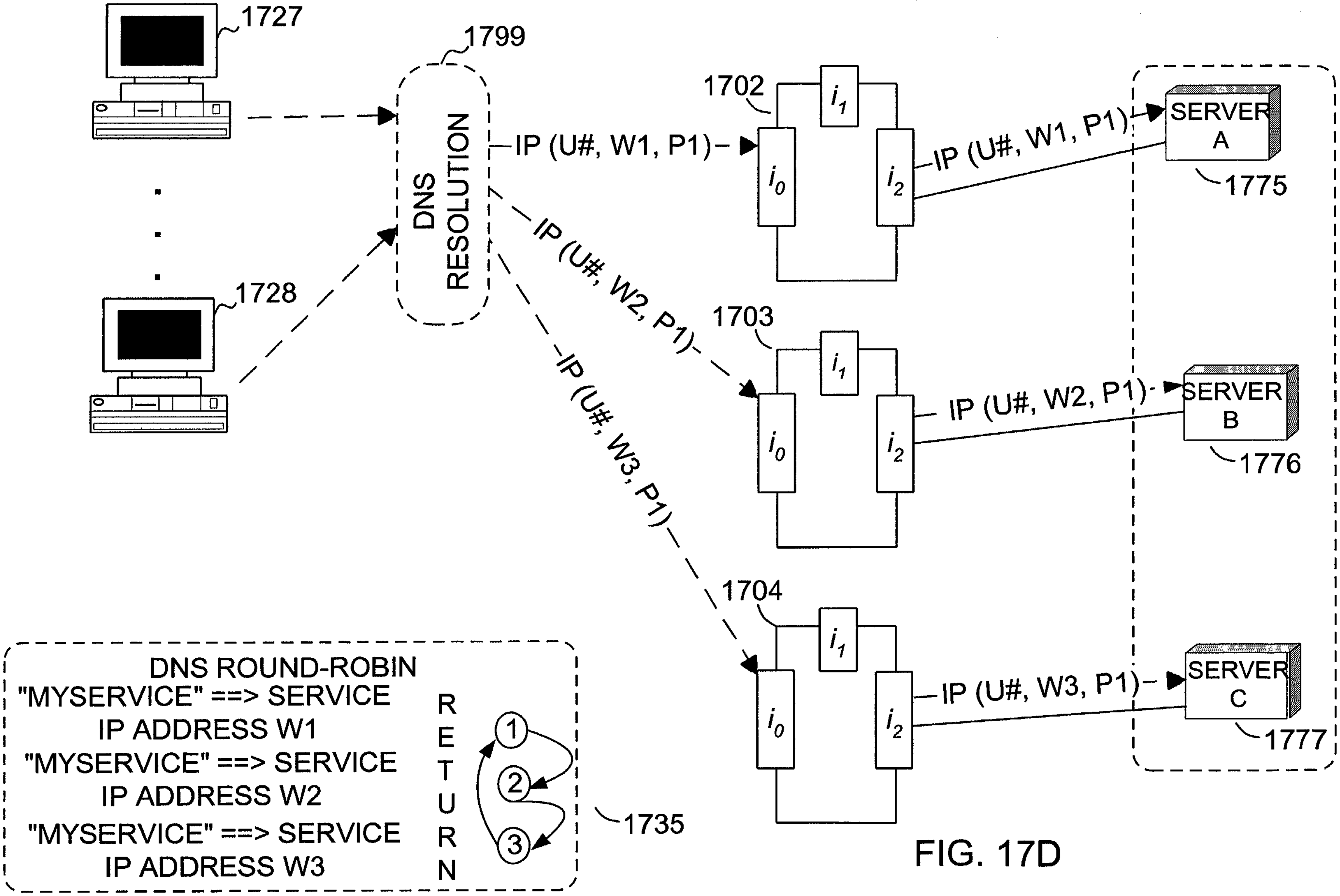


FIG. 17D

FIG. 17E

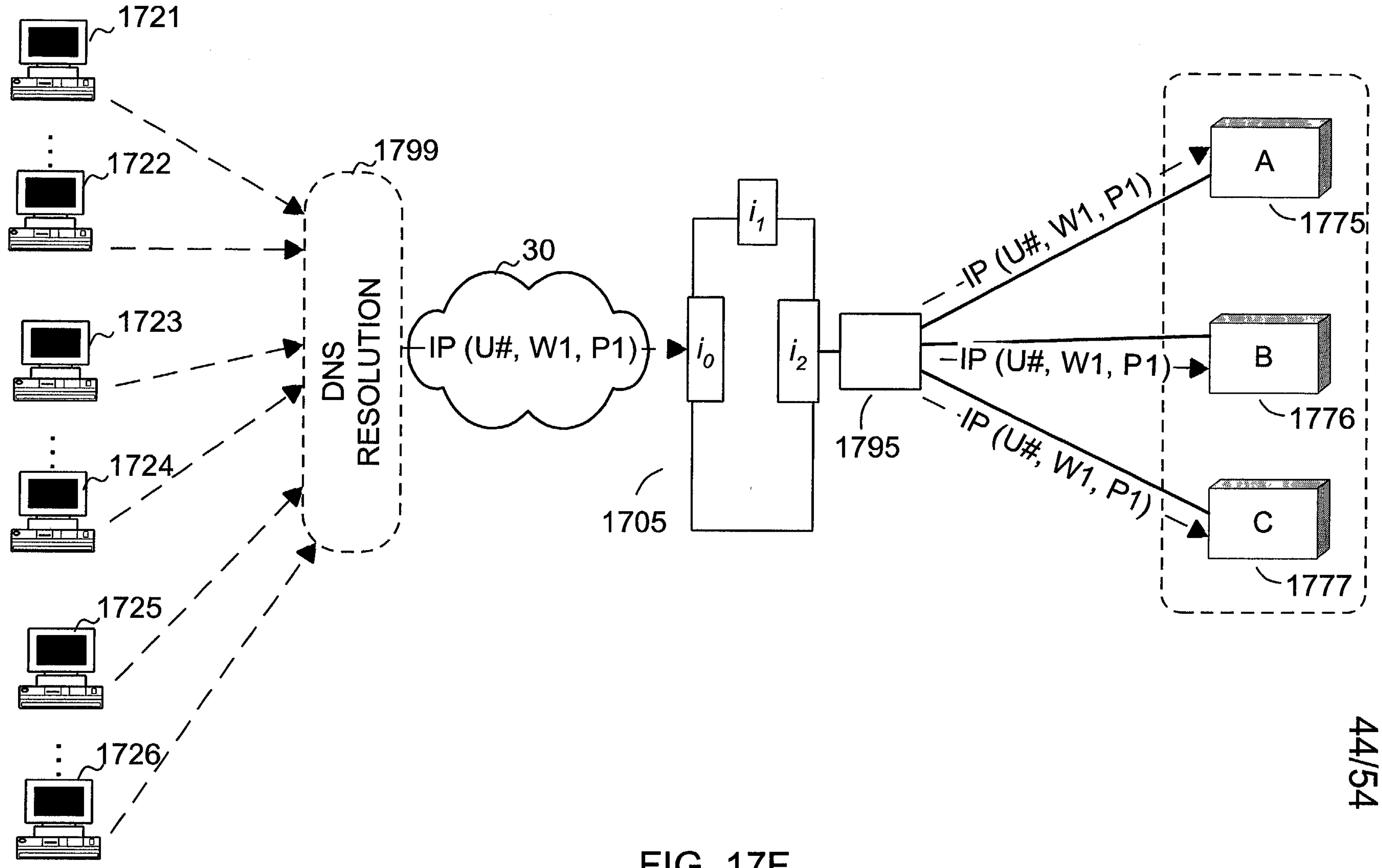

1721
1722
1723
1724
1725
1726
1799
DNS RESOLUTION
30
IP (U#, W1, P1)
i_0
i_1
i_2
1705
1795
IP (U#, W1, P1)
IP (U#, W1, P1)
IP (U#, W1, P1)
A
B
C
1775
1776
1777

FIG. 17F

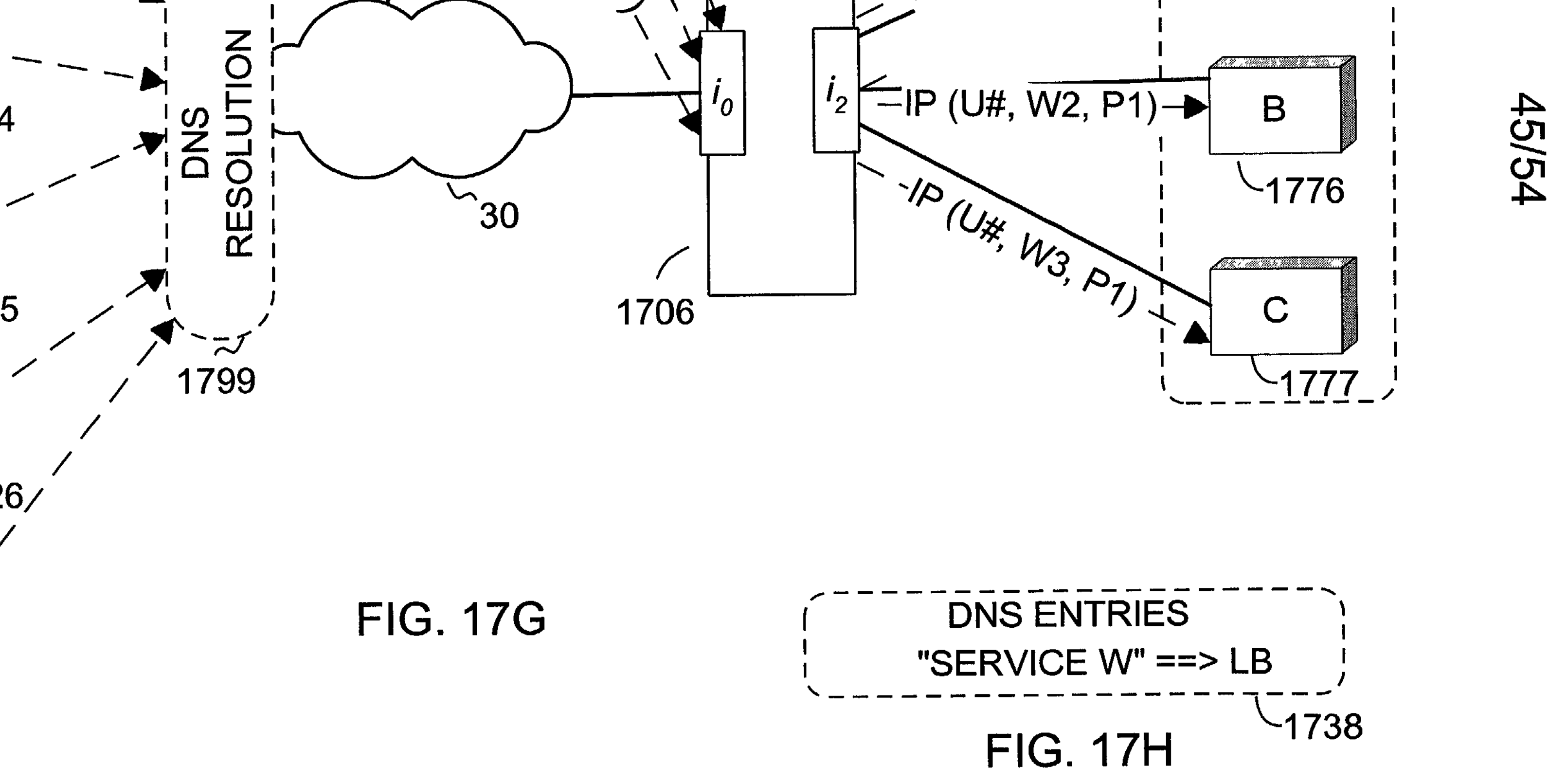


FIG. 17G

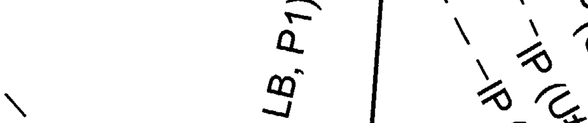


FIG. 17H

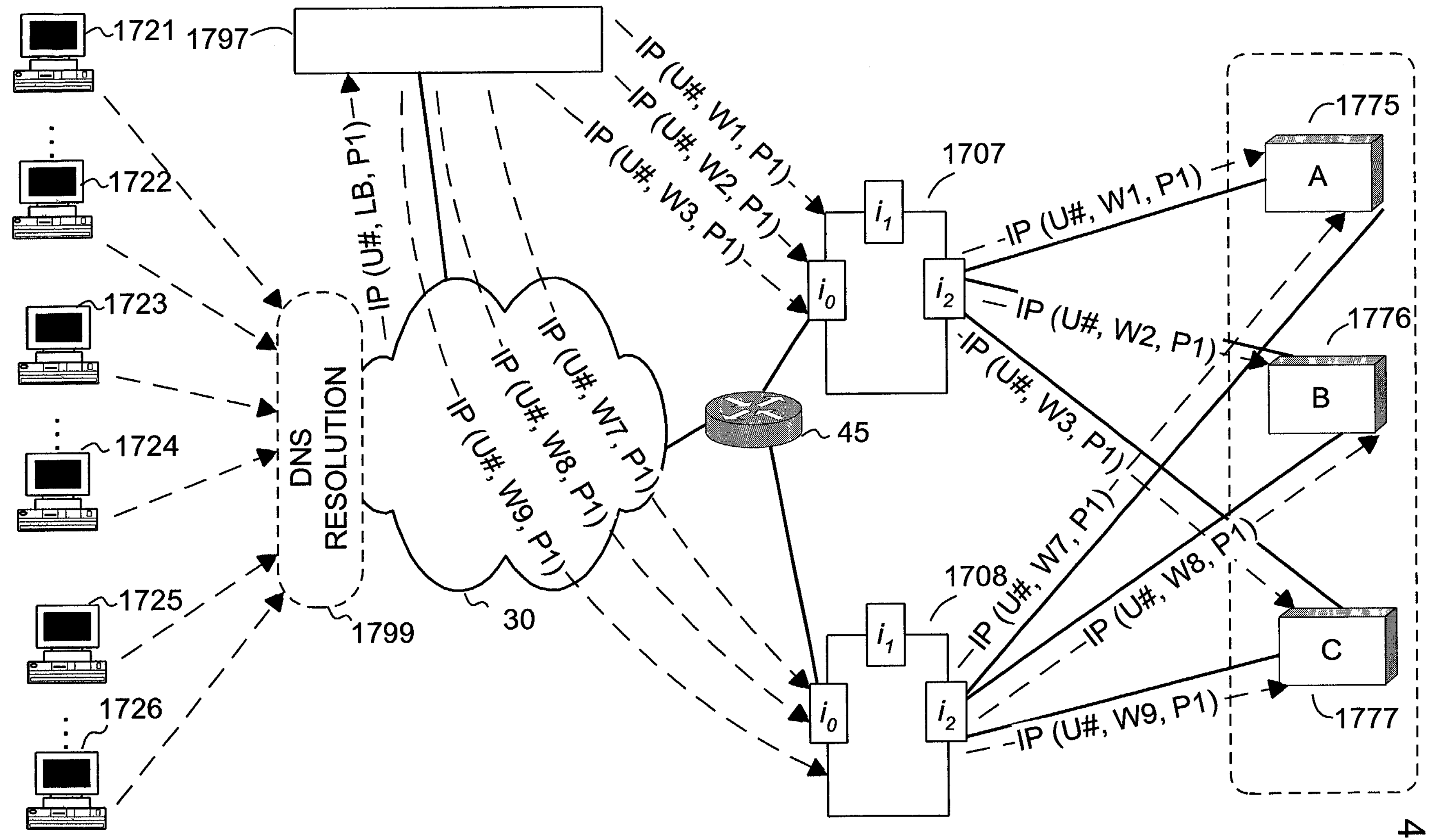

1721
1722
1723
1724
1725
1726
1797
DNS RESOLUTION
1799
IP (U#, LB, P1)
30
IP (U#, W1, P1)
IP (U#, W2, P1)
IP (U#, W3, P1)
IP (U#, W7, P1)
IP (U#, W8, P1)
IP (U#, W9, P1)
45
1707
i_0
i_1
i_2
1708
i_0
i_1
i_2
IP (U#, W1, P1)
IP (U#, W2, P1)
IP (U#, W3, P1)
IP (U#, W7, P1)
IP (U#, W8, P1)
IP (U#, W9, P1)
A
1775
B
1776
C
1777

FIG. 17I

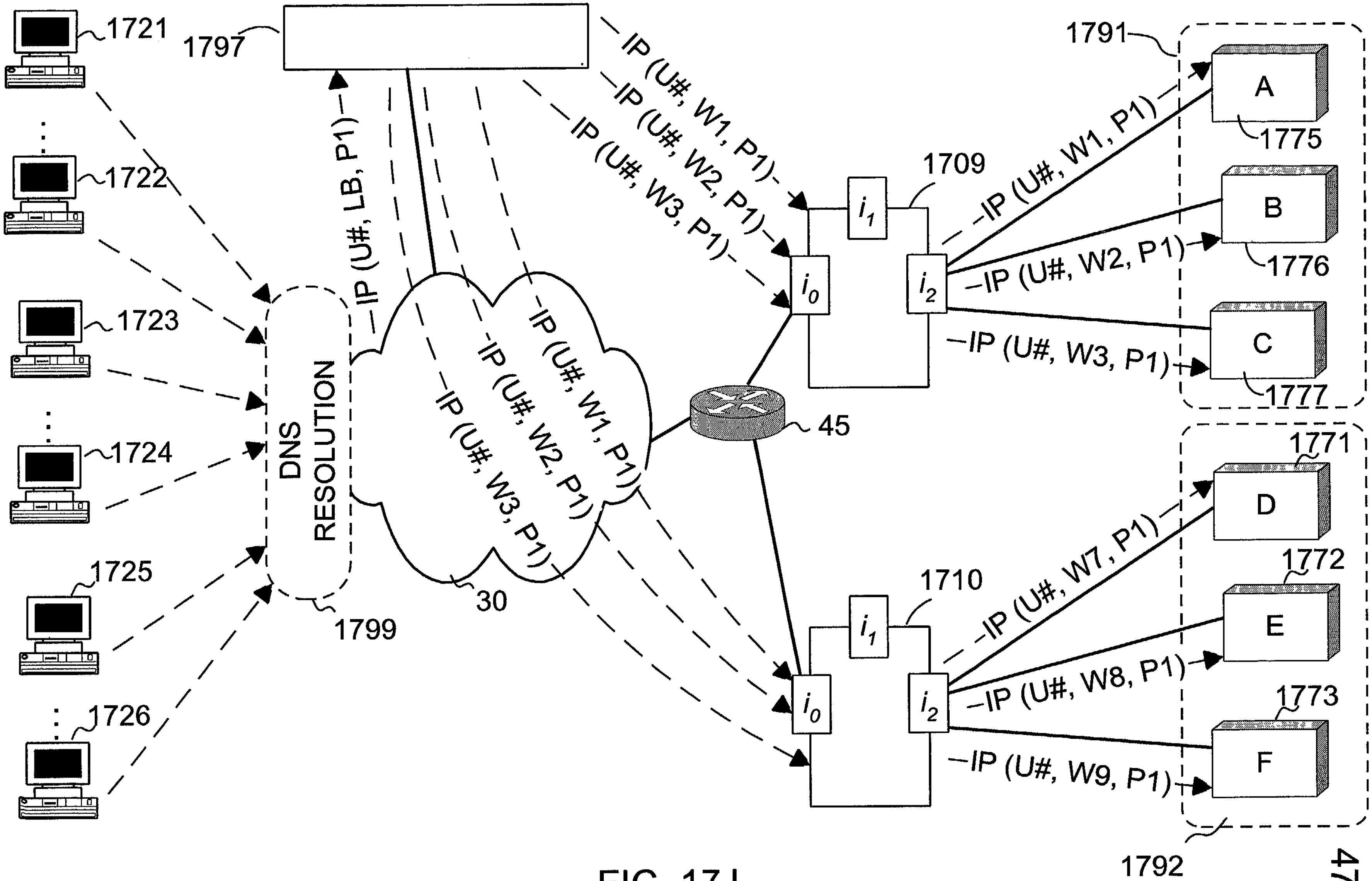

1721
1722
1723
1724
1725
1726
1797
1799
DNS RESOLUTION
IP (U#, LB, P1)
30
IP (U#, W1, P1)
IP (U#, W2, P1)
IP (U#, W3, P1)
45
1709
1710
i_0
i_1
i_2
IP (U#, W7, P1)
IP (U#, W8, P1)
IP (U#, W9, P1)
1791
1792
A
B
C
D
E
F
1775
1776
1777
1771
1772
1773

FIG. 17J

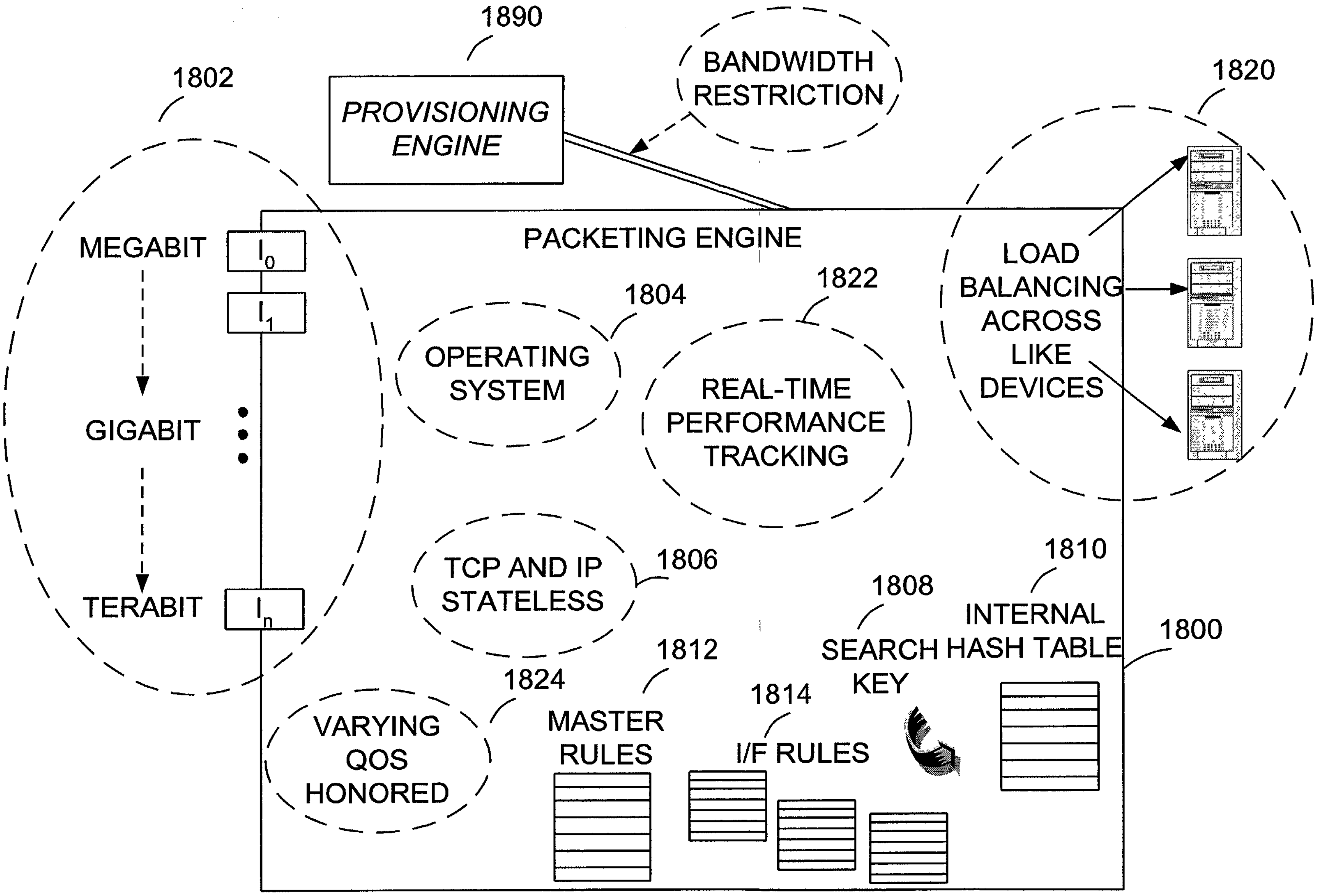
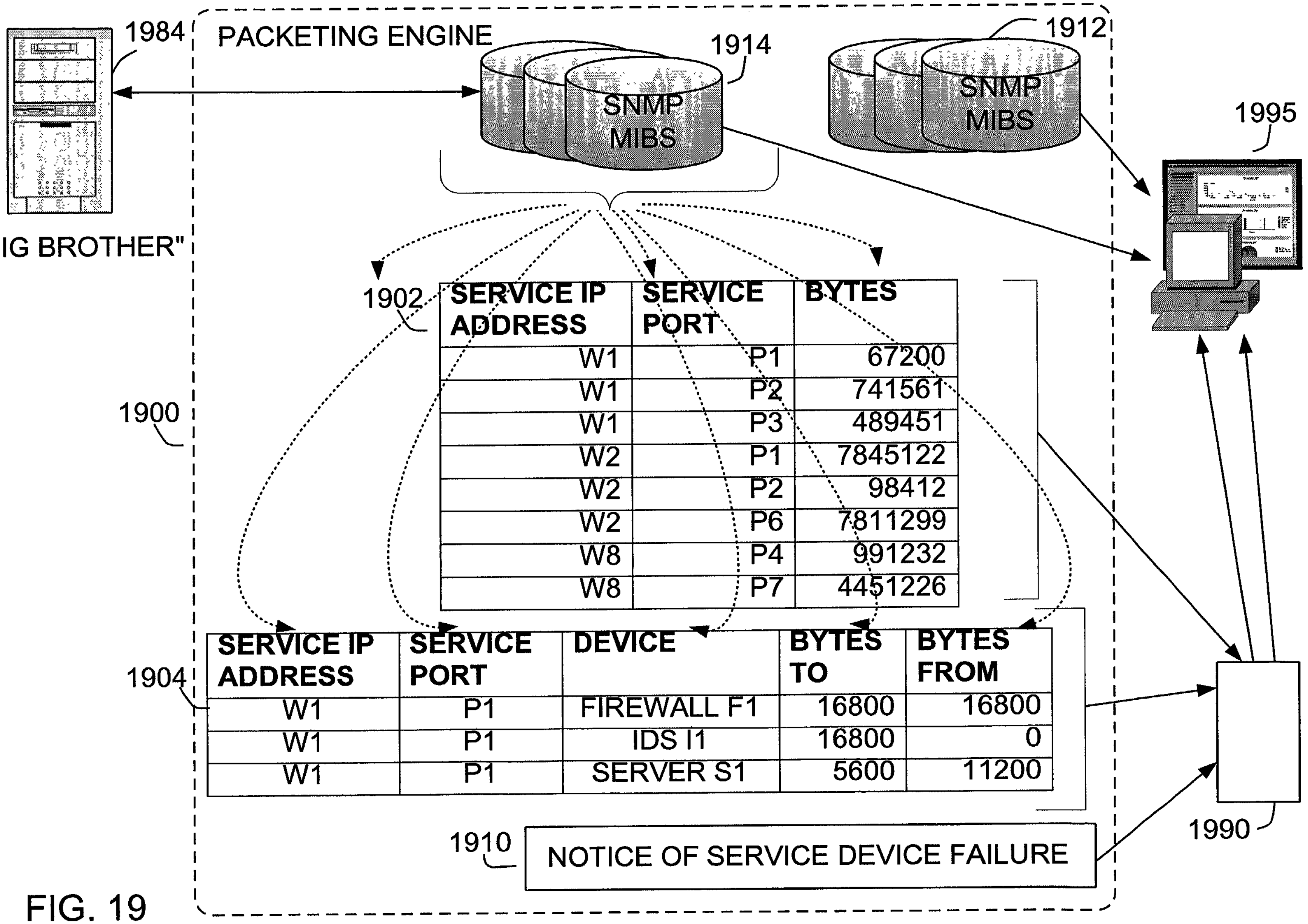

1890
PROVISIONING ENGINE
BANDWIDTH RESTRICTION
1802
1820
MEGABIT
GIGABIT
TERABIT
I_0
I_1
I_n
PACKETING ENGINE
1804
OPERATING SYSTEM
1822
REAL-TIME PERFORMANCE TRACKING
LOAD BALANCING ACROSS LIKE DEVICES
1806
TCP AND IP STATELESS
1810
1808
INTERNAL HASH TABLE
SEARCH KEY
1800
1812
1824
VARYING QOS HONORED
MASTER RULES
1814
I/F RULES

FIG. 18



SERVICE IP ADDRESS	SERVICE PORT	BYTES
W1	P1	67200
W1	P2	741561
W1	P3	489451
W2	P1	7845122
W2	P2	98412
W2	P6	7811299
W8	P4	991232
W8	P7	4451226

SERVICE IP ADDRESS	SERVICE PORT	DEVICE	BYTES TO	BYTES FROM
W1	P1	FIREWALL F1	16800	16800
W1	P1	IDS I1	16800	0
W1	P1	SERVER S1	5600	11200

FIG. 19

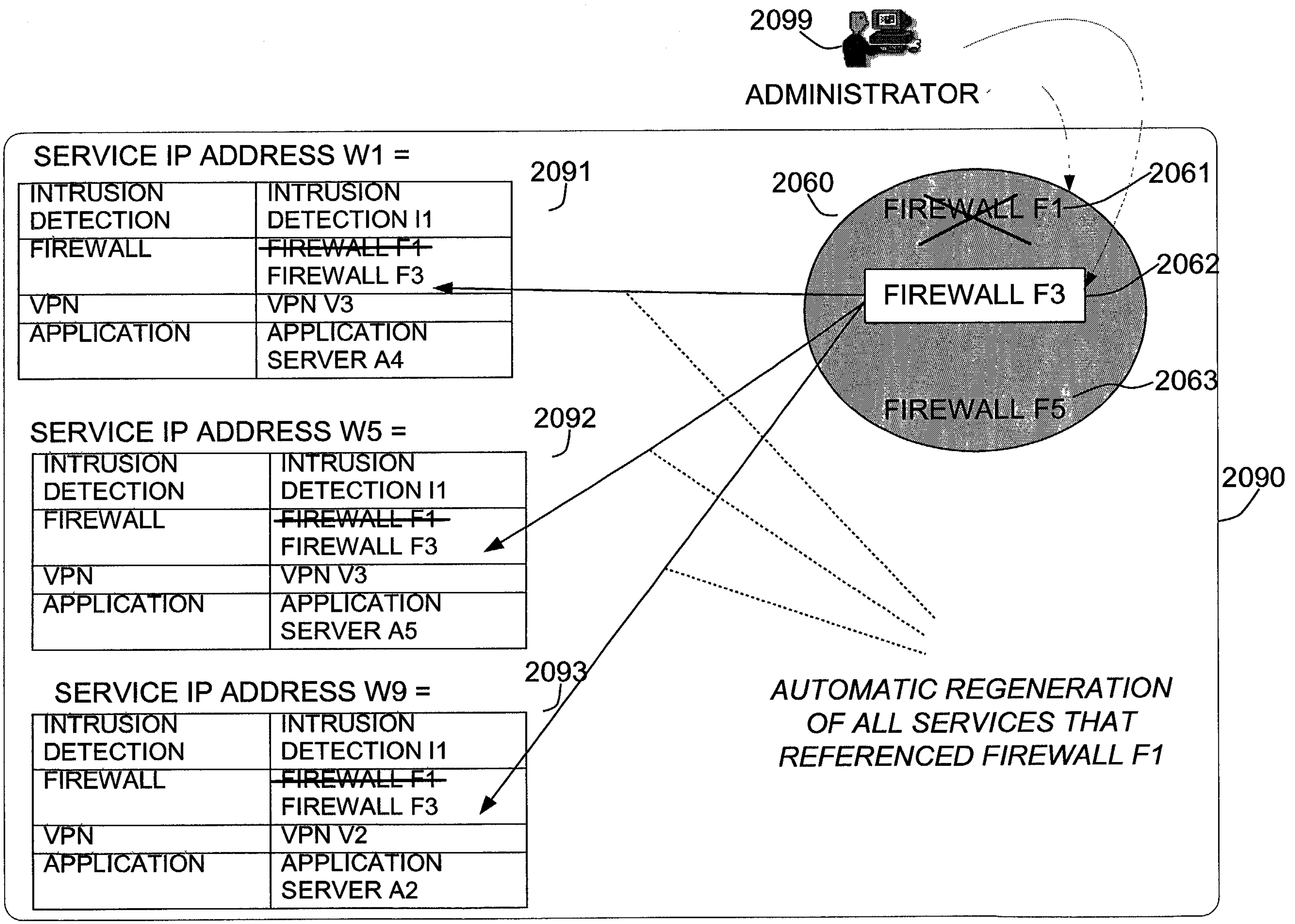
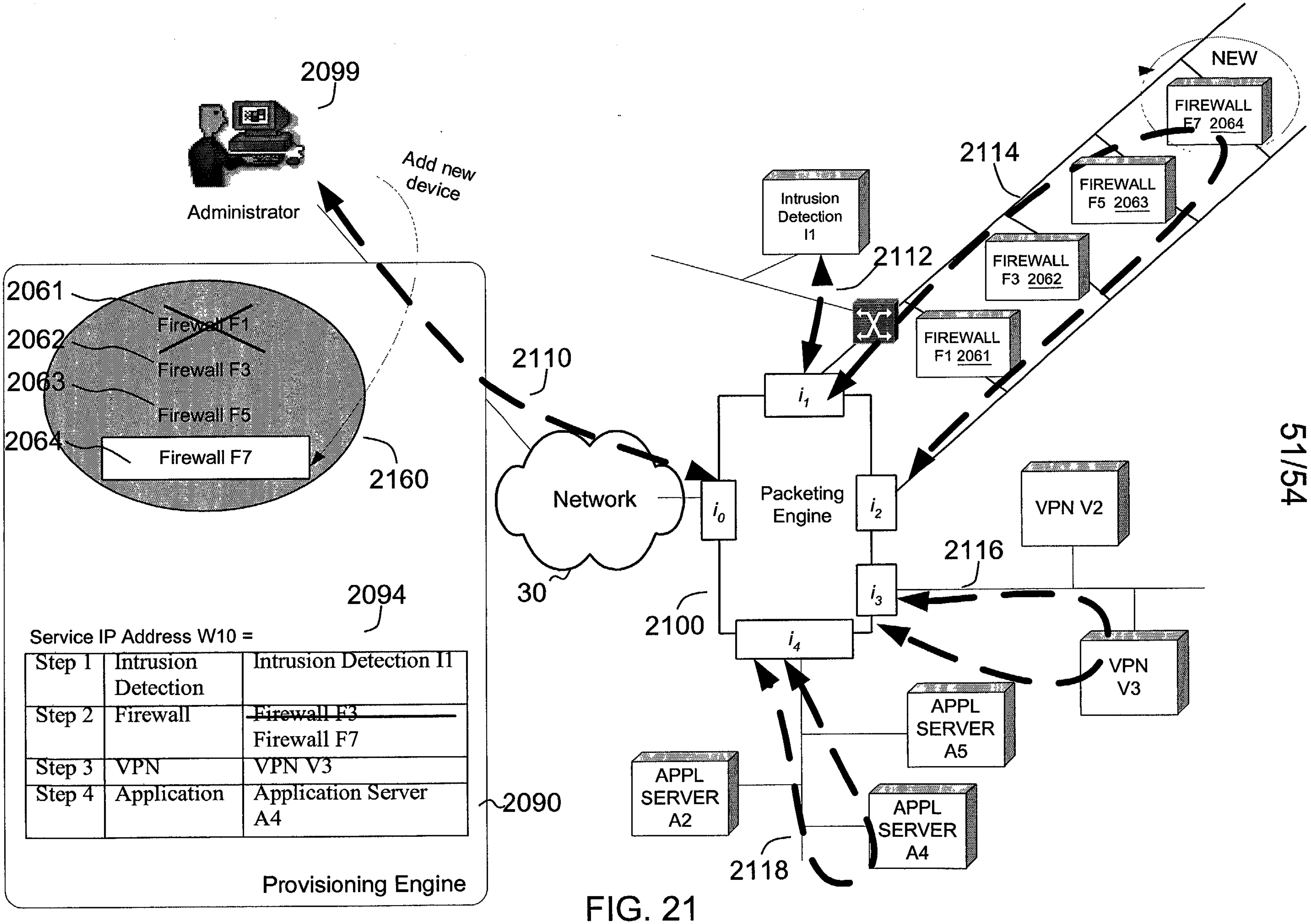

2099
ADMINISTRATOR
SERVICE IP ADDRESS W1 =
INTRUSION DETECTION
INTRUSION DETECTION I1
FIREWALL
~~FIREWALL F1~~
FIREWALL F3
VPN
VPN V3
APPLICATION
APPLICATION SERVER A4
2091
2060
~~FIREWALL F1~~
2061
FIREWALL F3
2062
FIREWALL F5
2063
2090
SERVICE IP ADDRESS W5 =
INTRUSION DETECTION
INTRUSION DETECTION I1
FIREWALL
~~FIREWALL F1~~
FIREWALL F3
VPN
VPN V3
APPLICATION
APPLICATION SERVER A5
2092
SERVICE IP ADDRESS W9 =
INTRUSION DETECTION
INTRUSION DETECTION I1
FIREWALL
~~FIREWALL F1~~
FIREWALL F3
VPN
VPN V2
APPLICATION
APPLICATION SERVER A2
2093
AUTOMATIC REGENERATION OF ALL SERVICES THAT REFERENCED FIREWALL F1

FIG. 20



Service IP Address W10 =

Step 1	Intrusion Detection	Intrusion Detection I1
Step 2	Firewall	~~Firewall F3~~ Firewall F7
Step 3	VPN	VPN V3
Step 4	Application	Application Server A4

FIG. 21

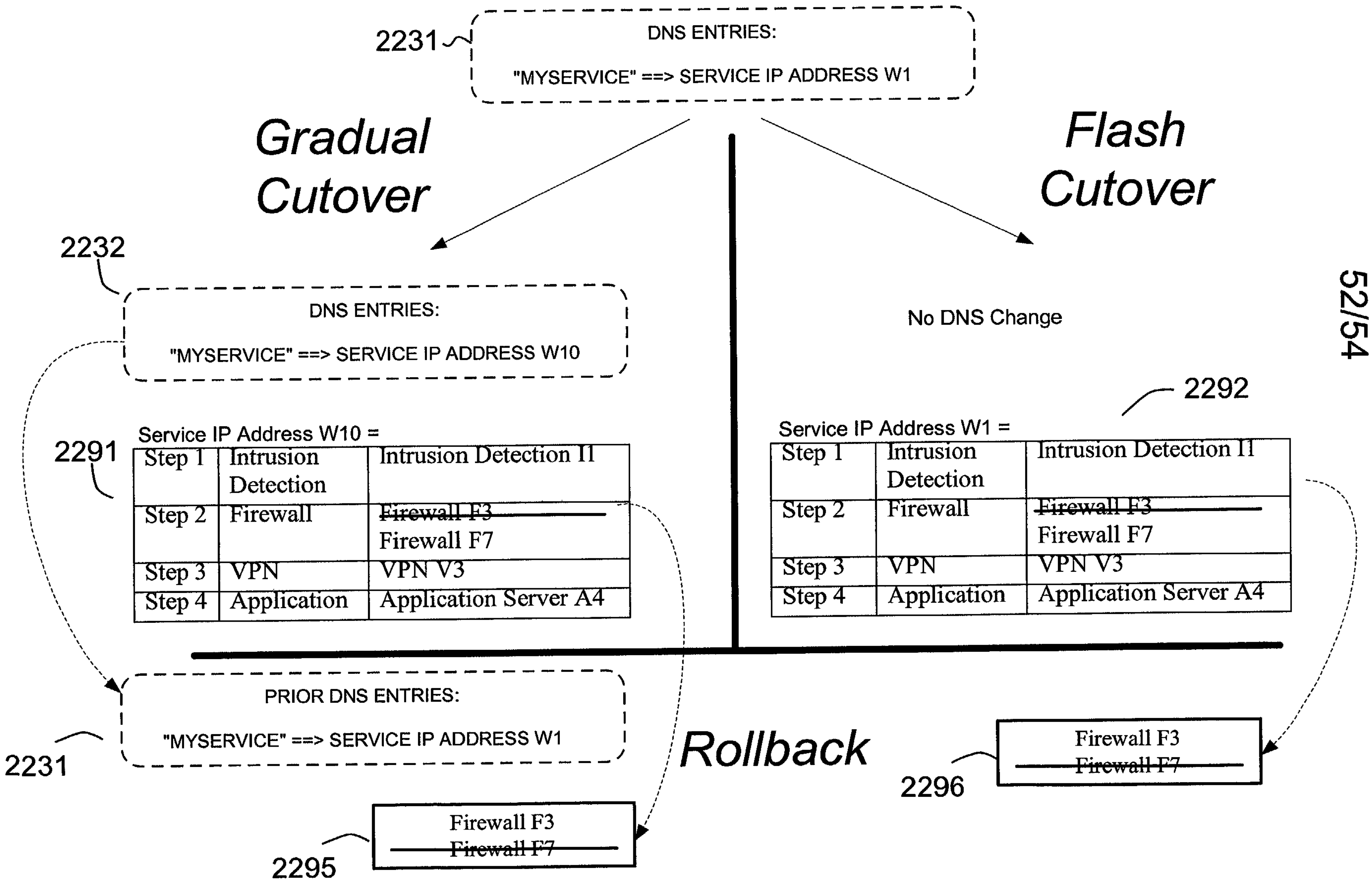

2231
DNS ENTRIES:
"MYSERVICE" ==> SERVICE IP ADDRESS W1
Gradual Cutover
Flash Cutover
2232
DNS ENTRIES:
"MYSERVICE" ==> SERVICE IP ADDRESS W10
No DNS Change
2291
Service IP Address W10 =
Step 1 Intrusion Detection Intrusion Detection I1
Step 2 Firewall ~~Firewall F3~~ Firewall F7
Step 3 VPN VPN V3
Step 4 Application Application Server A4
2292
Service IP Address W1 =
Step 1 Intrusion Detection Intrusion Detection I1
Step 2 Firewall ~~Firewall F3~~ Firewall F7
Step 3 VPN VPN V3
Step 4 Application Application Server A4
2231
PRIOR DNS ENTRIES:
"MYSERVICE" ==> SERVICE IP ADDRESS W1
Rollback
2296
Firewall F3
~~Firewall F7~~
2295
Firewall F3
~~Firewall F7~~

FIG. 22

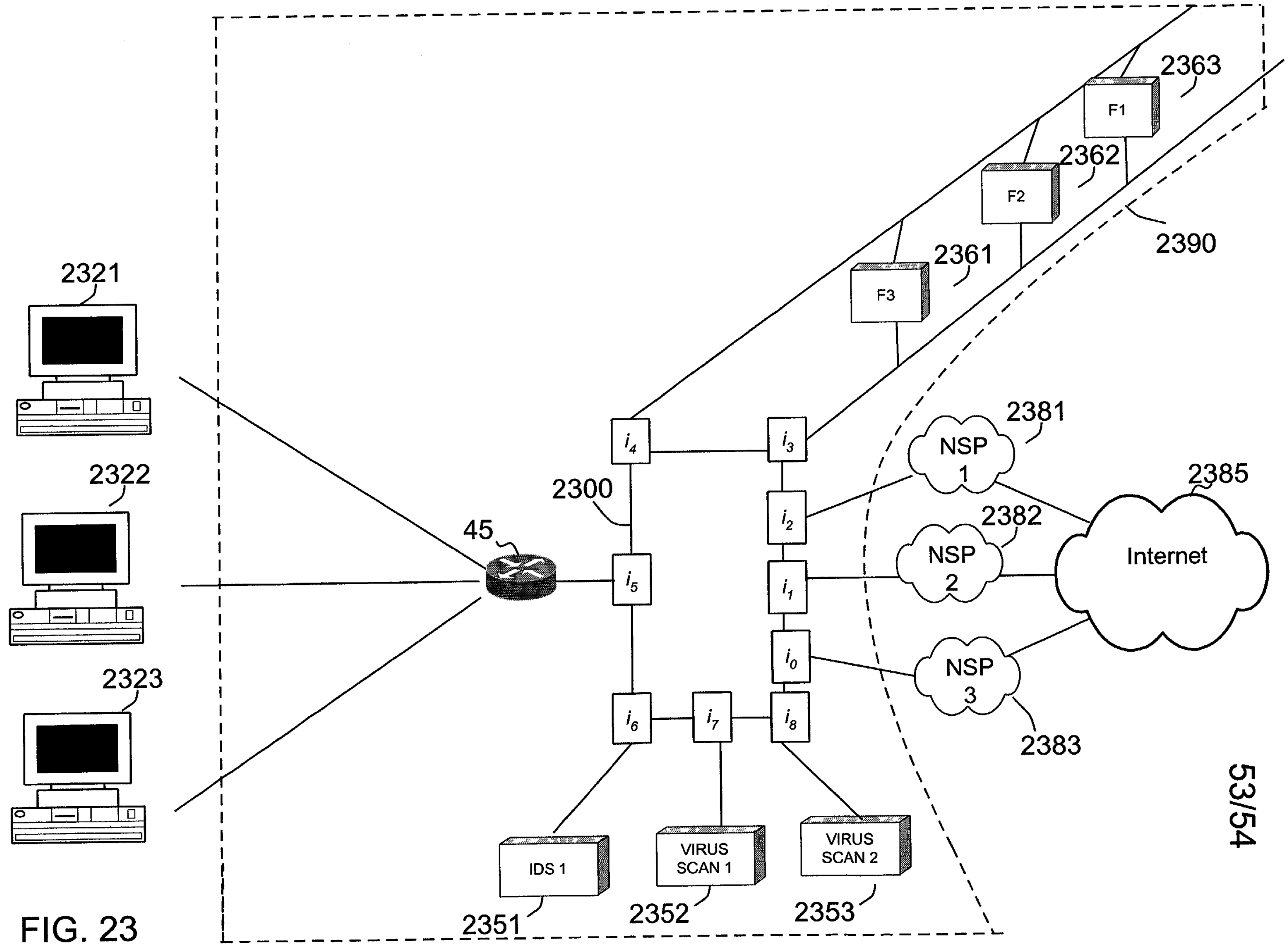

2321
2322
2323
45
2300
i_4
i_5
i_6
i_7
i_8
i_3
i_2
i_1
i_0
F1
F2
F3
2363
2362
2361
2390
NSP 1
NSP 2
NSP 3
2381
2382
2383
Internet
2385
IDS 1
VIRUS SCAN 1
VIRUS SCAN 2
2351
2352
2353

FIG. 23

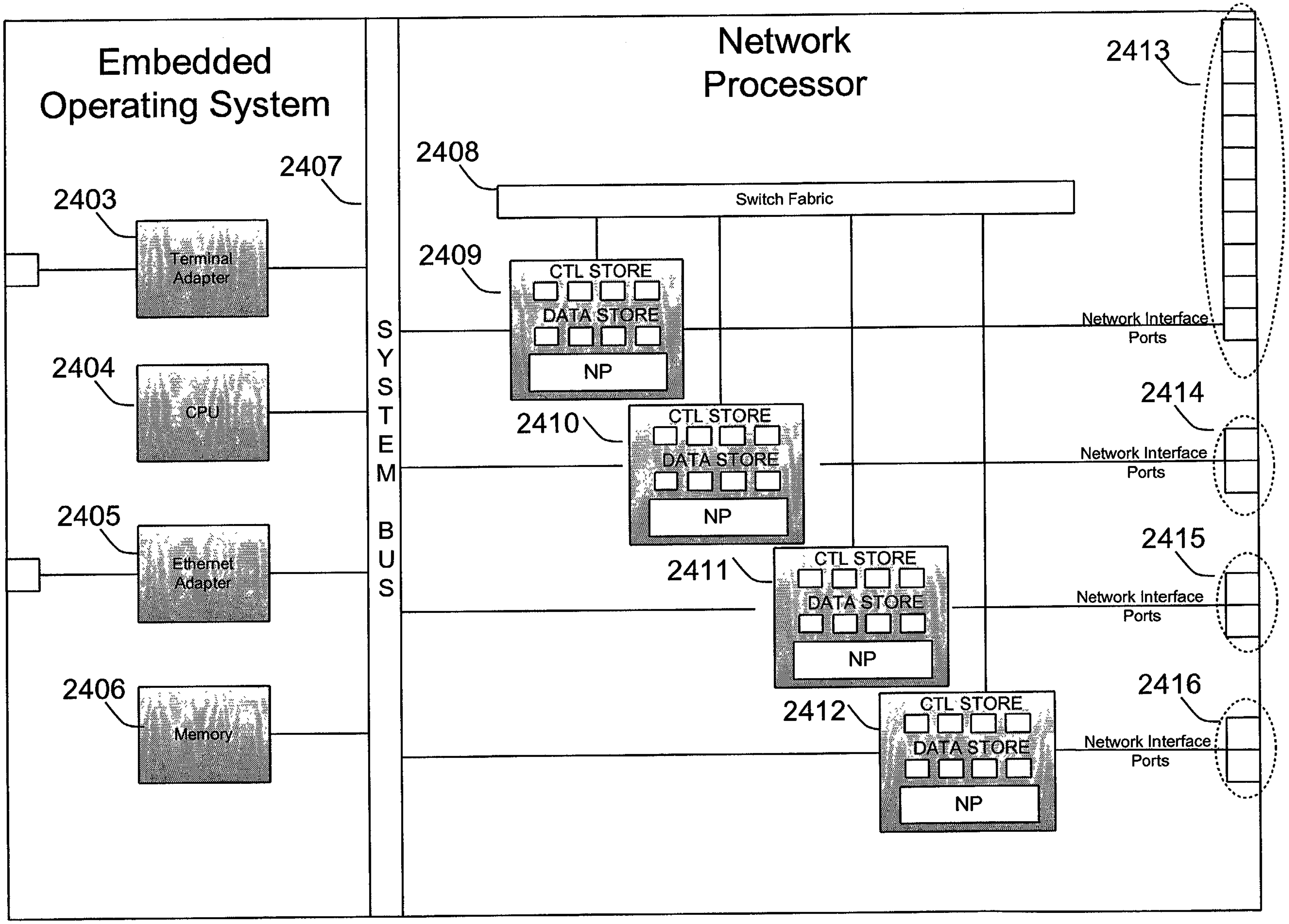

Embedded
Operating System
2403
Terminal Adapter
2404
CPU
2405
Ethernet Adapter
2406
Memory
2407
SYSTEM BUS
Network
Processor
2408
Switch Fabric
2409
2410
2411
2412
CTL STORE
DATA STORE
NP
2413
2414
2415
2416
Network Interface Ports

FIG. 24